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WAR MACHINE

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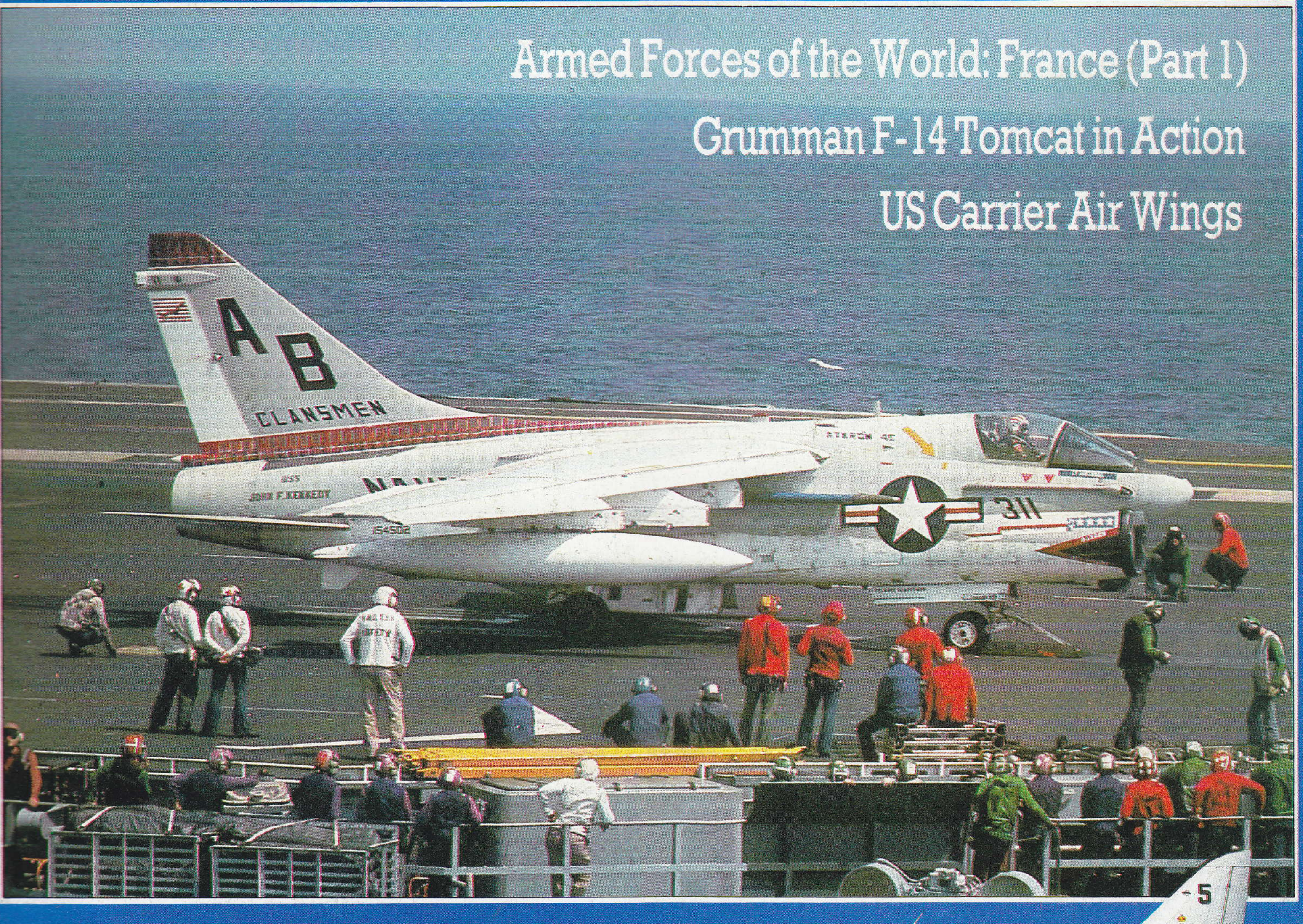

Armed Forces of the World: France (Part 1)

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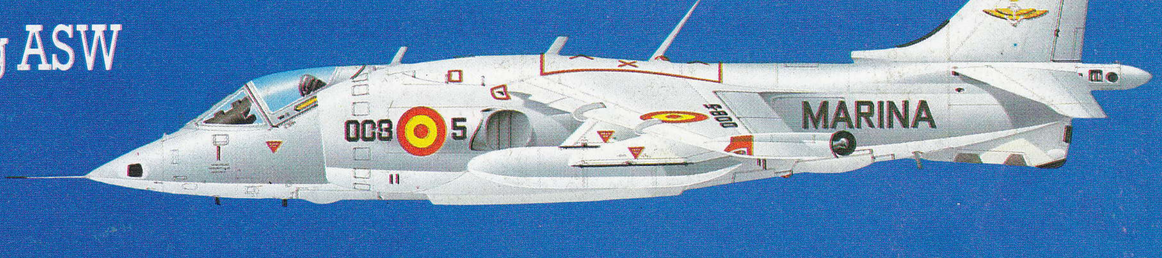

Carrier Fixed-Wing ASW

Sea Harriers
in Action

A fully illustrated guide to Carrierborne Aircraft

WAR MACHINE

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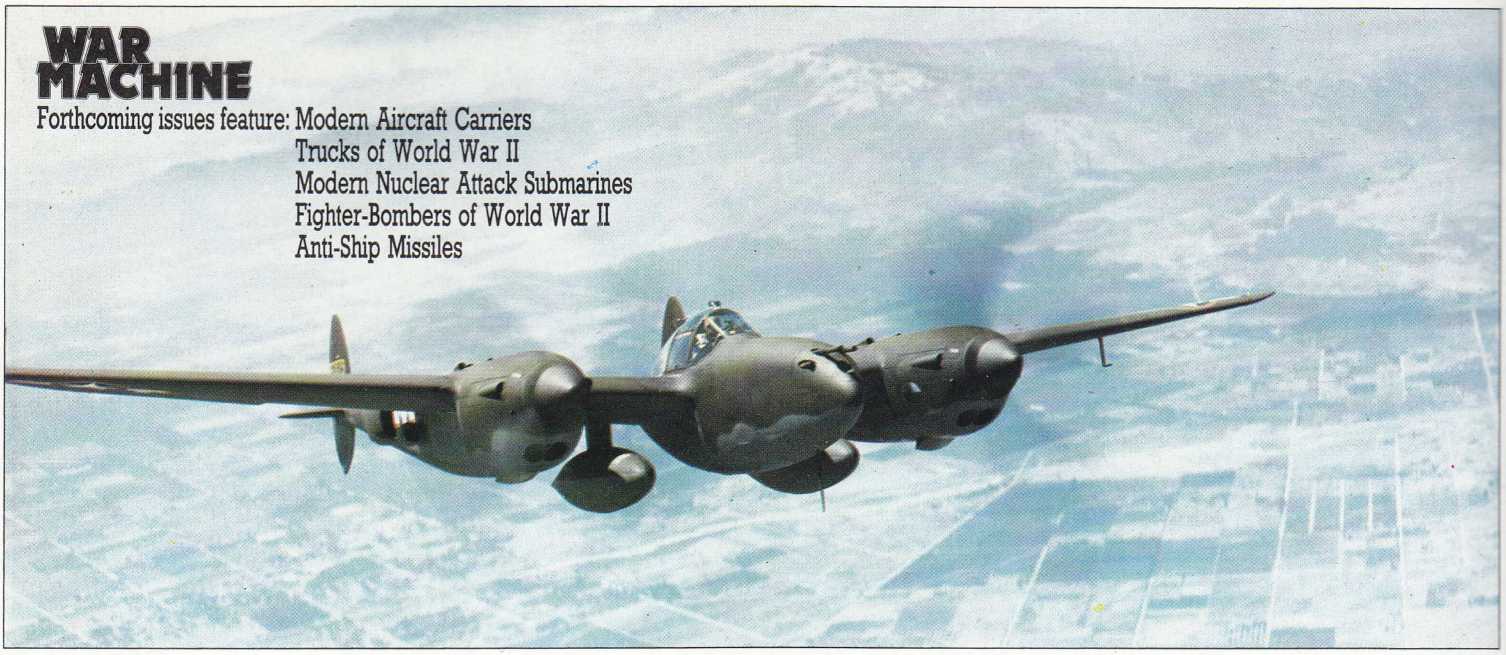


WAR MACHINE
Forthcoming issues feature: Modern Aircraft Carriers
Trucks of World War II
Modern Nuclear Attack Submarines
Fighter-Bombers of World War II
Anti-Ship Missiles

Carrierborne Aircraft

Preparing for a 'cat-shot' from the deck of USS John F. Kennedy, *this Vought A-7E Corsair II carries practice missiles on its fuselage pylons and long-range tanks on the outer wing pylons.*

There is no war machine that expresses greater power than those aircraft that operate from modern carriers. Concentrated into a tight airframe are powerful engines, sophisticated avionics, the very best weapon systems and very professional aircrews, combining to produce an awesome military asset of tremendous potency.

There can be few more impressive sights than a giant aircraft-carrier at full speed with up to 80 aircraft, wings and rotors folded, ranged on its acres of deck in closely-spaced lines. This is the epitome of power at sea, and a daunting challenge to the air forces of nations which border the world's oceans. The prime importance of the aircraft-carrier, both as an escort for shipping and an instrument of attack, was confirmed in World War II, and the lesson has been driven home in operations off the coasts of Korea, Vietnam and the Falkland Islands in subsequent years.

That two-thirds of the modern carrierborne aircraft described in the pages which follow are of American origin is no accident or result of bias. Simply, it is confirmation of the unquestionable fact that the US Navy possesses by far the most powerful seagoing air arm (in fact, the US Navy has in its own right the world's third-largest air force), based on over a dozen major vessels and a similar number of comparatively smaller 'flat-tops' including those for the US Marine Corps. Though its specifications for new aircraft invariably demand multiple capabilities, the US Navy can boast a separate type for almost every role demanded of embarked aviation.

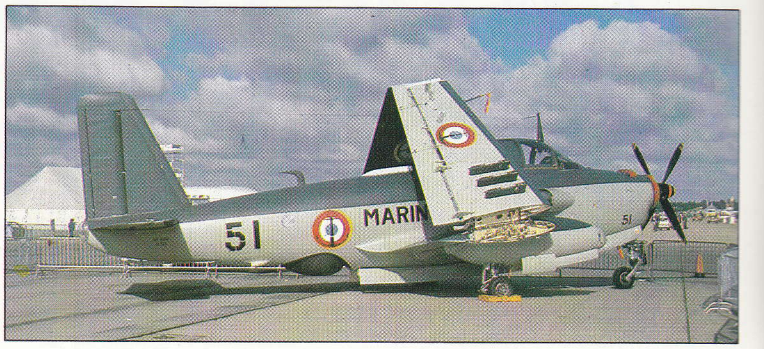
France and the UK, whilst eclipsed as naval powers, continue development of carrierbased fixed-wing aircraft, but both the Dassault-Breguet Super Etendard and BAe Sea Harrier are tasked with air defence and strike missions for reasons of economy and available stowage. Specialized early-warning, ECM and modern patrol aircraft are absent from the decks of these navies, and as the UK yet again discovered in 1982, this omission can endanger the theoretical effectiveness of surface combatants and their aircraft.

The USSR is represented by just a single rudimentary VTOL carrier-based aircraft, indicating a belated recognition of the potentialities of a seagoing air force. The form of the aircraft which undoubtedly will follow the Yakovlev Yak-36MP remains a matter of conjecture in the West, but their purpose is abundantly clear: naval power, meaning naval air power, is the key to control of 70 percent of the globe.

With the world's third-largest air arm, the United States Navy dominates the carrier aircraft scene. They operate 13 carriers with another four under construction or on commission. Of the many types of aircraft carried, the Vought A-7 Corsair II is one of the most numerous, operating in the strike role.

FRANCE

Breguet Alizé



The Breguet Alizé has been in operation with the French navy (Aéronavale) for many years. It has a retractable ventral radome for its role of anti-submarine warfare.

Principal anti-submarine patrol aircraft of the French and Indian navies for more than two decades, the **Breguet Br.1150 Alizé** evolved from a late-1940s design for a carrier-based attack aircraft, the **Br.960 Vultur**, in which a turboprop engine was augmented by a jet to give sprint performance during critical phases of its mission. The Vultur failed to proceed beyond the prototype stage, but l'Aéronavale ordered the similar, though much slower, Alizé for ASW duties. With a larger fuselage, accommodating three crew, and a smaller wing, the prototype flew in 1956.

Carrying a search radar in a ventral 'dustbin' which retracts into the rear fuselage when not in use, the Alizé may be armed with depth charges, rockets or air-to-surface missiles. Sonobuoy stowage is in the large wing fairings which also house the main landing gear units. Series production amounted to 87 aircraft, of which 12 were ordered by the Indian Navy for service aboard the carrier *Vikrant* and at shore bases, these seeing heavy utilization during the 1971 war with Pakistan.

To some extent, the Alizé's duties with l'Aéronavale have been assumed by the Aérospatiale Super Frelon helicopter, but two operational squadrons continue to fly the type, and deployments are regularly undertaken aboard the carriers *Foch* and *Clemenceau*. A well-deserved (and necessary) refit programme is currently in progress to update 28 aircraft for service into the 1990s. Amongst new systems being installed are a Thomson-CSF Iguane radar, SERCEL-Crouzet VLF Omega inertial navigation system, electronic support measures (ESM) equipment, new communications systems and other improved avionics. Under original plans the Alizé would now be extinct in Europe, but now both its operators plan to keep the aircraft in service until their present carriers are withdrawn.

Specification

Dassault-Breguet Br.1050 Alizé

Type: three-seat carrier-based anti-submarine aircraft

Powerplant: one 1,975-shp (1,473-kW) Rolls-Royce Dart RDa.7 Mk 21 turboprop

Performance: maximum speed 518 km/h (322 mph) at 3050 m (10,000 ft); patrol speed 240-370 km/h (149-230 mph); service ceiling 8000 m (26,245 ft); normal range 2500 km (1,553 miles); maximum endurance 7 hours 40 minutes

Weights: empty equipped 5700 kg (12,566 lb); maximum take-off 8200 kg (18,078 lb)

Dimensions: span 15.60 m (51 ft 2 in); length 13.86 m (45 ft 6 in); height 5.00 m (16 ft 4¾ in); wing area 36.00 m^2 (387.51 sq ft)

Armament: underfuselage weapons bay accommodating one torpedo or three 160-kg (353-lb) depth charges; racks under inner wings for two 160-kg (353-lb) or 175-kg (386-lb) depth charges; racks beneath outer wings for six 12.7-cm (5-in) rockets or two Nord AS.12 air-to-surface missiles; and sonobuoys in underwing weapon/wheel nacelles

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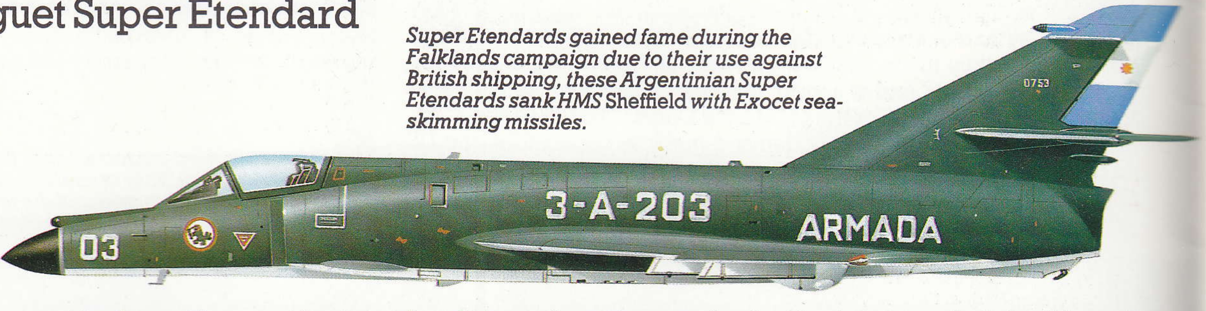
FRANCE

Dassault-Breguet Super Etendard



Super Etendards gained fame during the Falklands campaign due to their use against British shipping, these Argentinian Super Etendards sank HMS* Sheffield *with Exocet sea-skimming missiles.

Principal front-line aircraft of the French navy's air arm (Aéronavale), the **Dassault-Breguet Super Etendard** serves with three squadrons and is regularly deployed aboard the carriers *Foch* and *Clemenceau*. The original **Etendard** shipboard strike-fighter evolved from a mid-1950s NATO requirement for a land-based aircraft, but when its replacement received consideration, an improved version was ordered in place of the originally-proposed navalized Jaguar.

The exacting French specification called for the standard aircraft to incorporate the strike and reconnaissance roles previously undertaken by two Etendard variants (**Etendard IVM** and **Etendard IVP** respectively), and combine this with a new air-defence capability. Accordingly, the Super Etendard was produced with Agave radar for attack as well as intercept duties, an inertial navigation system (SKN 2602) with head-up display and provision for a wide range of underwing stores, including Matra R 550 Magic infra-red AAMs and hose-equipped tanks for 'buddy' refuelling. Aerodynamic improvements concerned a revised wing with drooped leading edges and double-slotted flaps, whilst a new (8K50) version of the well-tried Atar engine gives additional thrust; no afterburner is fitted.

Having entered service in 1978, the Super Etendard was supplied to Argentina from 1981 onwards, the first five of 14 on order seeing operational use from land bases in the Falklands war, destroying two British ships with their potent AM.39 Exocet missiles. The single Argentine squadron achieved carrier qualification aboard the *Veinticinco de Mayo* early in 1983. At the same time, production was completed of 71 Super Etendards for l'Aéronavale, but in response to an Iraqi request, five of these (together with 20 Exocets) were sold to the air force for operations in the Gulf against Iranian targets, particularly offshore oil installations. Delivery took place in October 1983.

Specification

Dassault-Breguet Super Etendard

Type: single-seat carrier-based attack aircraft

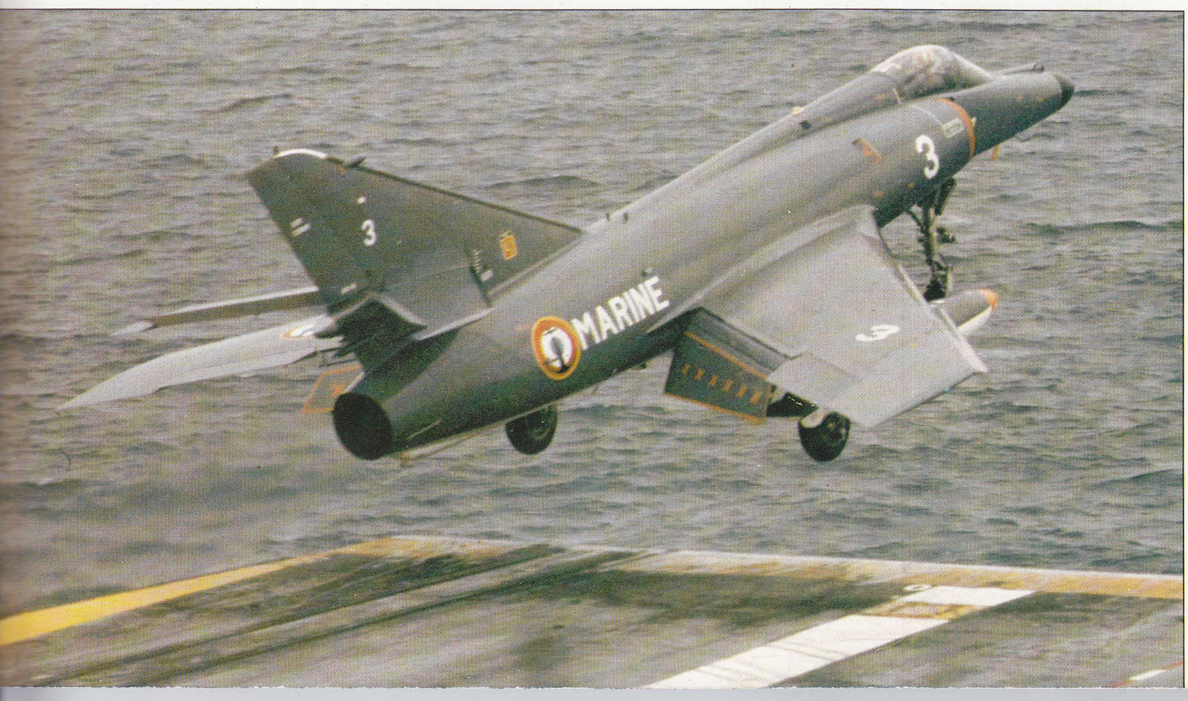
Powerplant: one 5000-kg (11,025-lb) thrust SNECMA Atar 8K50 turbojet

Performance: maximum speed at low altitude, clean 1200 km/h (748 mph); initial climb rate 6000 m (19,685 ft) per minute; service ceiling 13700 m (44,950 ft); radius on a hi-lo-hi mission with one AM39 and one tank 650 km (403 miles)

Weights: empty 6450 kg (14,220 lb); maximum take-off (allows maximum weapons or maximum fuel, but not both) 11500 kg (25,350 lb)

Dimensions: span 9.6 m (31 ft 6 in); length 14.31 m (46 ft 11½ in); height 3.86 m (12 ft 8 in); wing area 28.4 m^2 (305.7 sq ft)

Armament: two 30-mm DEFA cannon each with 125 rounds; fuselge pylons for two 551-lb (250-kg) bombs, four wing hardpoints for 882-lb (400-kg) bombs, rocket pods or Magic AAMs; alternatively one AM39 Exocet ASM under the right wing and one 242-Imp gal (1100-litre) tank under the left wing



***The third Super Etendard seen during carrier trials; the double slotted flaps are depressed for maximum lift. They are deployed aboard the carriers* Foch *and* Clemenceau.**

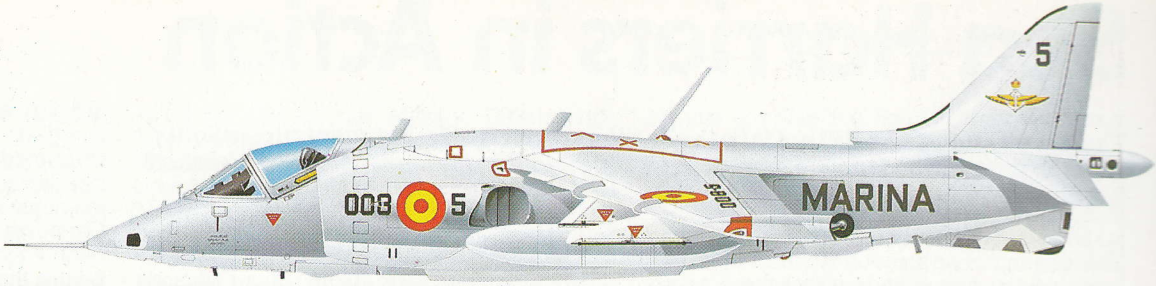
UK

BAe AV-8A/C

A Harrier which regularly goes to sea but is not a Sea Harrier, the **BAe AV-8A** is the US Marines' version of the RAF Harrier, in service with three operational squadrons and a training unit. As such it is principally a ground-attack aircraft, lacking the laser nose retrospectively fitted to British variants but ideally suited to the US Marines' requirements for a high-performance close-support aircraft which can operate at sea from compartively small assault carriers and then redeploy to the beach-head to work beside the disembarked troops. On one occasion, AV-8As have formed part of a Navy Carrier Air Wing aboard the USS *Franklin D. Roosevelt*, whilst the type has occasionally been deployed from its base at Cherry Point to a forward station at Iwakuni, Japan.

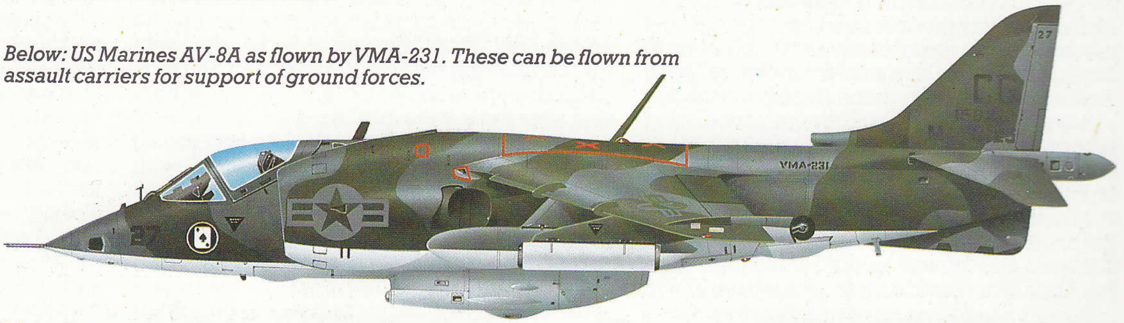
Although American personnel flew a military evaluation version of the original P.1127, known as the Kestrel, USMC interest in the Harrier's unique capabilities did not develop into a production order until some years later. The first of an eventual 102 AV-8As and eight two-seat **TAV-8A** trainers was delivered in 1971, but because several small batches were ordered, plans for US manufacture could not be implemented, and all AV-8As were built in the UK. Power was provided by the Pegasus 11 engine, although the first 10 had Pegasus 10s when delivered. Six AV-8As and two TAV-8As were ordered through US channels by Spain for use aboard the carrier *Dédalo*, followed by a further five direct from BAe. These have the local designations **VA.1** for the single-seaters and **VAE.1** for the trainers.

AV-8As remaining in service with the USMC have been converted to **AV-8C** standard by incorporation of some features of the AV-8B (described separately), including the retractable dam near the gun ports and larger gunpod strakes. These augment take-off lift by forming a cushion of exhaust gases from the Pegasus' swivelling nozzles. Avionics and systems are totally new.



With the Spanish navy designation VA.1, BAe Harriers fly from the carrier Dédalo*. These are similar to the US Marines' AV-8A and are known as Matadors.*

Below: US Marines AV-8A as flown by VMA-231. These can be flown from assault carriers for support of ground forces.



Specification

BAe AV-8C

Type: single-seat ship- or land-based light attack fighter

Powerplant: one 9752-kg (21,500-lb) thrust Rolls-Royce Pegasus Mk 103 vectoring-thrust turbofan

Performance: maximum speed over 1186 km/h (737 mph) or Mach 0.97 at low altitude; climb to 12190 m (40,000 ft) in 2 minutes 22 seconds; service ceiling more than 15240 m (50,000 ft); combat radius with 1361-lb (3,000-lb) external stores load 95 km (59 miles) after VTO or 705 km (438 miles) after a 365-m (1,200-ft) run

Weights: empty 5529 kg (12,190 lb); maximum take-off 7734 kg (17,050 lb) for VTO or 10115 kg (22,300 lb) for STO

Dimensions: span 7.70 m (25 ft 3 in); length 13.87 m (45 ft 6 in); height 3.45 m (11 ft 4 in); wing area 18.68 m^2 (201.1 sq ft)

Armament: two 30-mm cannon, plus up to 2404 kg (5,300 lb) of disposable ordnance on five hardpoints, plus two AIM-9 Sidewinder air-to-air missiles

UK

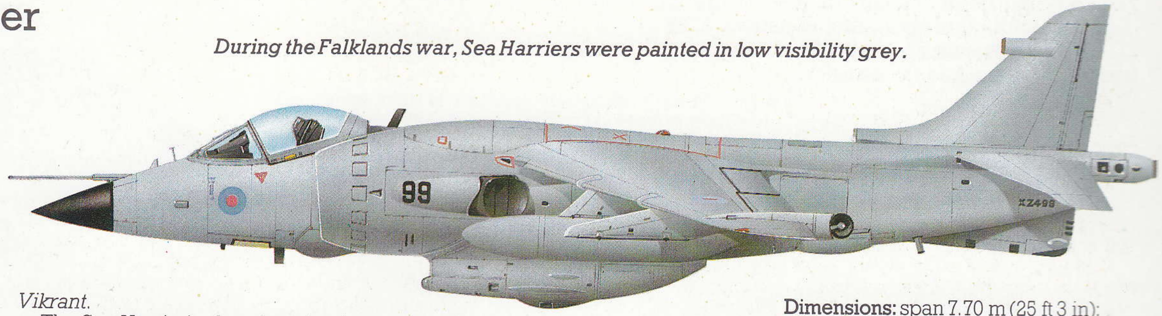
BAe Sea Harrier

Derived from the RAF Harrier, which preceded it in squadron service by a full 10 years, the **BAe Sea Harrier** was ordered into production in 1975 by the Royal Navy for service aboard the three 'Invincible' class ASW carriers, or 'through-deck' cruisers. Prime requirement was for a multi-role aircraft, and thus the Sea Harrier added a nose radome for Ferranti Blue Fox air-intercept radar and two (later increased to four) AIM-9L Sidewinder AAMs on wing pylons to give fleet-defence capability. Retaining, in addition, the Harrier's ground-attack and tactical reconnaissance roles, the navalized variant is equipped to carry Sea Eagle anti-ship missiles when these enter service in the mid-1980s.

Sea Harriers became operational in April 1980 and performed with distinction during the Falklands war of April-June 1982, when they destroyed 20 Argentine aircraft without loss. Only two Sea Harriers were shot down by ground fire in over 1,100 combat air patrol missions and 90 offensive support operations, undertaken by a force of 28 aircraft during hostilities, Sea Harriers returning a remarkable 95 per cent serviceability and flying 99 per cent of all sorties planned. For take-off at maximum weight, the aircraft uses a short run terminating in a ramp, or 'ski jump' but employs vertical thrust for landing, even when poor weather prohibits flying by other fixed-wing carrier aircraft. Royal Navy **Sea Harrier FRS.Mk 1** orders currently total 48, whilst a further six **Sea Harrier FRS.Mk 51** fighters and two **Sea Harrier T.Mk 60** trainers were delivered to the Indian Navy for operation from the carrier *Vikrant*.

The Sea Harrier's already extensive capabilities will be further improved by a refit programme during the late-1980s, in which a new pulse-Doppler radar and four Hughes AIM-120 AMRAAM radar-guided missiles will provide a look-down/shoot-down potential, displacing Sidewinders to the wingtips. Aerodynamic improvements, involving leading-edge root extensions (LERX) will enhance combat manoeuvrability.

During the Falklands war, Sea Harriers were painted in low visibility grey.



Specification

BAe Sea Harrier FRS.Mk 1

Type: single-seat V/STOL ship-based multi-role combat aircraft

Powerplant: one 9752-kg (21,500-lb) thrust Rolls-Royce Pegasus Mk 104 vectored-thrust turbofan

Performance: maximum speed 'over 1185 km/h (736 mph)' at sea level; dive limit Mach 1.25; climb to 12190 m (40,000 ft) in 2 minutes 20 seconds; service ceiling more than 15240 m (50,000 ft); radius without inflight-refuelling (high-altitude interception) 750 km (460 miles), or (low-level strike) 463 km (288 miles)

Weights: empty 5670 kg (12,500 lb); maximum take-off more than 11794 kg (26,000 lb)

Dimensions: span 7.70 m (25 ft 3 in); length 14.50 m (47 ft 7 in); height 3.71 m (12 ft 2 in); wing area 18.68 m^2 (201.1 sq ft)

Armament: two 30-mm Aden cannon each with 125 rounds (optional); underwing loads can include all weapons of Harrier plus AIM-9L or (India) Magic AAMs and Sea Eagle, Harpoon or other anti-ship missiles

'Black Death' became the Sea Harrier's name amongst Argentinian pilots who tried to attack the British task force. This example is from No. 899 Sqn, Royal Navy.

Sea Harriers in Action

There were some who did not take the Sea Harrier seriously. But events in the South Atlantic soon proved them dramatically wrong; seldom had a warplane established its reputation so rapidly.

The Argentine occupation force in the Falklands was at first confident that the 'English' would not come; the Argentine occupation of the Falkland Islands on 2 April 1982 had been swift and wholly successful, and considerable reinforcements and defensive weapons were now in position; no one would dare to challenge their presence on the islands it pleased them to call the Malvinas. As Rear-Admiral John 'Sandy' Woodward's task force drew closer with its two V/STOL carriers, 20 BAe Sea Harrier FRS.Mk 1s, warships and troopships, the defenders entertained few doubts on their ability to administer a punishing defeat: had not their media declared 'Sandy' was a stupid name and, ergo, the Task Force leader was incompetent?

Bravado and illogical optimism were nevertheless underpinned by a well-founded faith in the men and aircraft of the Fuerza Aérea Argentina (FAA). Many pilots had been trained by US instructors, and their principal combat aircraft, the Dassault Mirage III, IAI Dagger (Israeli-built Mirage 5) and Douglas A-4 Skyhawk, all possessed impeccable combat records, notably with the Israeli Defence Force. Outnumbered five-to-one, the Royal Navy could field only the Sea Harrier: an aircraft untried in battle and regarded in some quarters as an impractical venture down a cul-de-sac of aeronautical design. A newcomer to naval service, the Sea Harrier had left the UK before it had been officially cleared to fire its main air combat weapon, the all-aspect AIM-9L Sidewinder missile, and this shortcoming had to be remedied on passage.

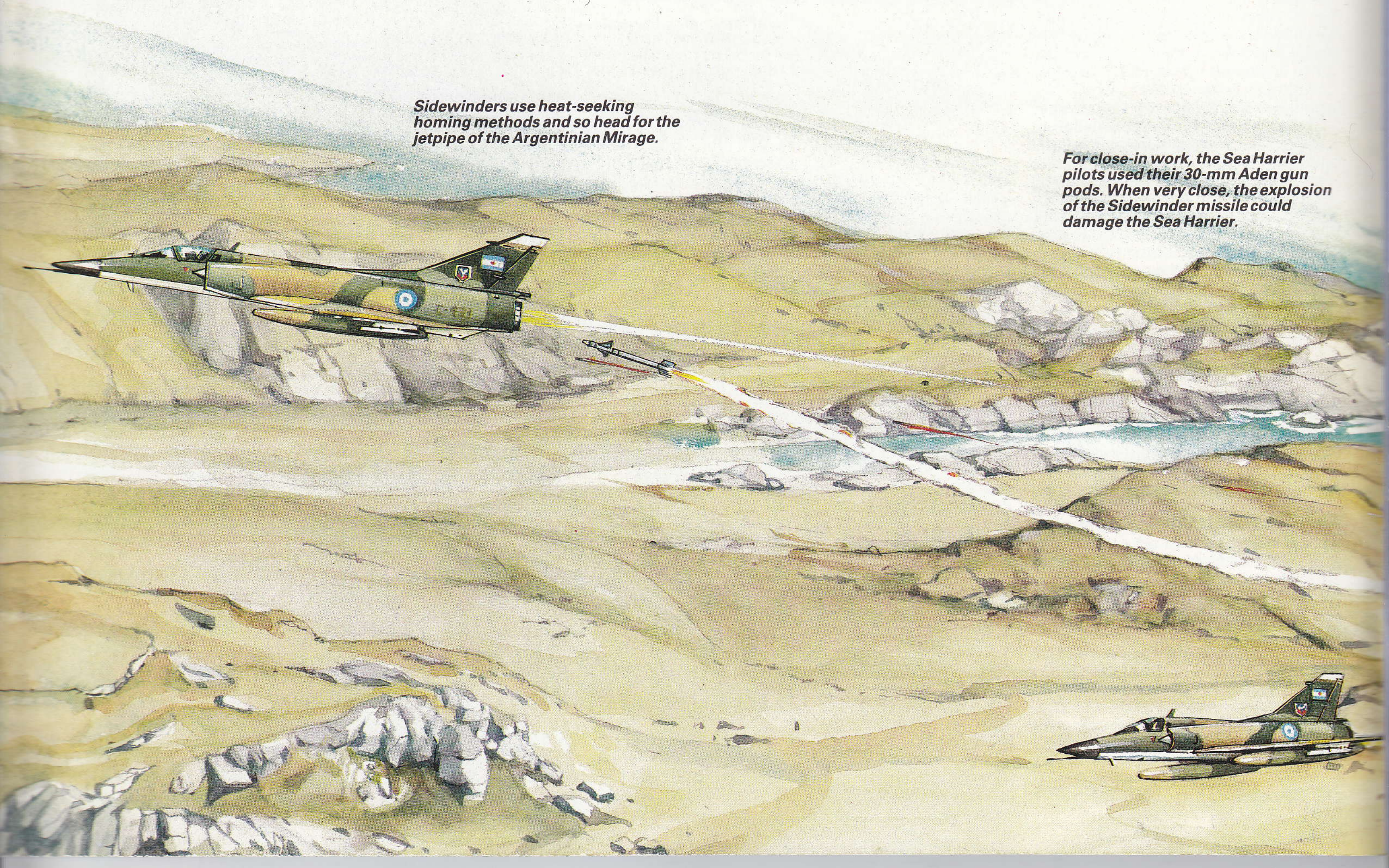
Galvanized into action by an Avro Vulcan and Sea Harrier attack on the major Falklands airfield at Port Stanley before dawn on 1 May, the FAA left its mainland bases some 645 km (400 miles) distant to exact revenge on the British fleet. First, however, it had to deal with the combat air patrols (CAP) of Sea Harriers (likewise operating at the limit of their range) and after some initial probing a second wave of Mirage IIIs dived on a patrol at supersonic speed, firing earlier-model AIM-9B Sidewinders head-on and streaking away at sea level. The missiles failed to hold lock and expended themselves harmlessly. Close-in combat appeared to be the key to success, and having lost none of their number, the Mirage pilots took false (even fatal) confidence from their first encounter with the Royal Navy's fighters.

Fireball and debris

Sacrificing their considerable speed advantage, the Mirage pilots made a more determined frontal attack later in the day, this tactical error allowing the Sea Harriers to manoeuvre rapidly and draw a bead on their assailants from the rear. A Sidewinder fired by Flight Lieutenant Paul Barton (an RAF officer on exchange posting with the Royal Navy) sped unerringly towards its hapless victim only 1.6 km (1 mile) distant, a fireball of burning fuel and debris belching from the Mirage as the missile's annular blast fragmentation warhead found its mark. Another Mirage fruitlessly attempted to even the score with its AIM-9B, but almost certainly fell to a second Sea Harrier moments later, and at least one Argentine BAC Canberra light bomber was torn apart by the deadly Sidewinder at almost wave-top height before the end of the first day.

Seldom in the history of air warfare have a few fleeting seconds of combat prompted such a fundamental reappraisal of a fighter by its enemies. Of all modern weapon systems, perhaps only the atomic bomb has established its clear superiority in a similarly short period and had such a profound effect on the outcome of a war. For the remainder of the conflict, the Sea Harrier's pre-eminence as a fighter was unchallenged by the FAA and no concerted attempt was made to entice the British aircraft into combat. Thus, the initiative and an immense psychological advantage was gained by the task force, confirmed by the Argentines' own name for the Sea Harrier: Black Death.

It was not until British soldiers landed on the Falklands on 21 May that further air fighting ensued, Argentina being unable to ignore such an affront to its newly-won territory. Daggers and Skyhawks were forced to run the gauntlet of the standing Sea Harrier CAPs and suffered grievously in the attempt, losing eight of their complement, together with an island-based FMA Pucará.



Sidewinders use heat-seeking homing methods and so head for the jetpipe of the Argentinian Mirage.

For close-in work, the Sea Harrier pilots used their 30-mm Aden gun pods. When very close, the explosion of the Sidewinder missile could damage the Sea Harrier.

In an early engagement, two Sea Harriers met a quartet of Skyhawks head-on at low level, the latter immediately jettisoning their bombs and fleeing for home, their opponents' reputation firmly in mind. With no top cover to protect them, the Skyhawks were easy meat for the agile Sea Harriers, and Lieutenant-Commander Neil Thomas in the lead fighter soon heard the characteristic growling tone in his headphones to confirm missile acquisition. A Sidewinder flashed from his underwing rails in pursuit of the stricken A-4, following it through cloud and striking home as it emerged from the cumulus. Wingman Lieutenant-Commander Mike Blissett tore open a second Skyhawk at almost the same instant, and both pilots then attacked the remaining pair of FAA aircraft without confirmed success.

Skyhawks suffered the majority of losses on 21 May, although Mirages did not escape unscathed when they stayed to 'mix it' with the potent Sea Harriers. Easily evading a missile fired by one of the enemy, Lieutenant-Commander Nigel Ward and Lieutenant Steve Thomas outmanoeuvred a brace of Daggers in a high-speed chase over the rough terrain of West Falkland, hacking down both within seconds and later claiming a third 'probable'. Severely mauled, the FAA retired to lick its wounds, having failed in its attempt to thwart the British landings and having sustained a further shattering blow to its morale. Those Argentine aircraft which had evaded interception suffered at the hands of the ship-based missiles and, later, those on shore, although they pressed home their attacks with courage and determination against these hazards and ground-fire. Confronted with Sea Harriers, they ditched their weapons and headed for base.

Sitting Herc

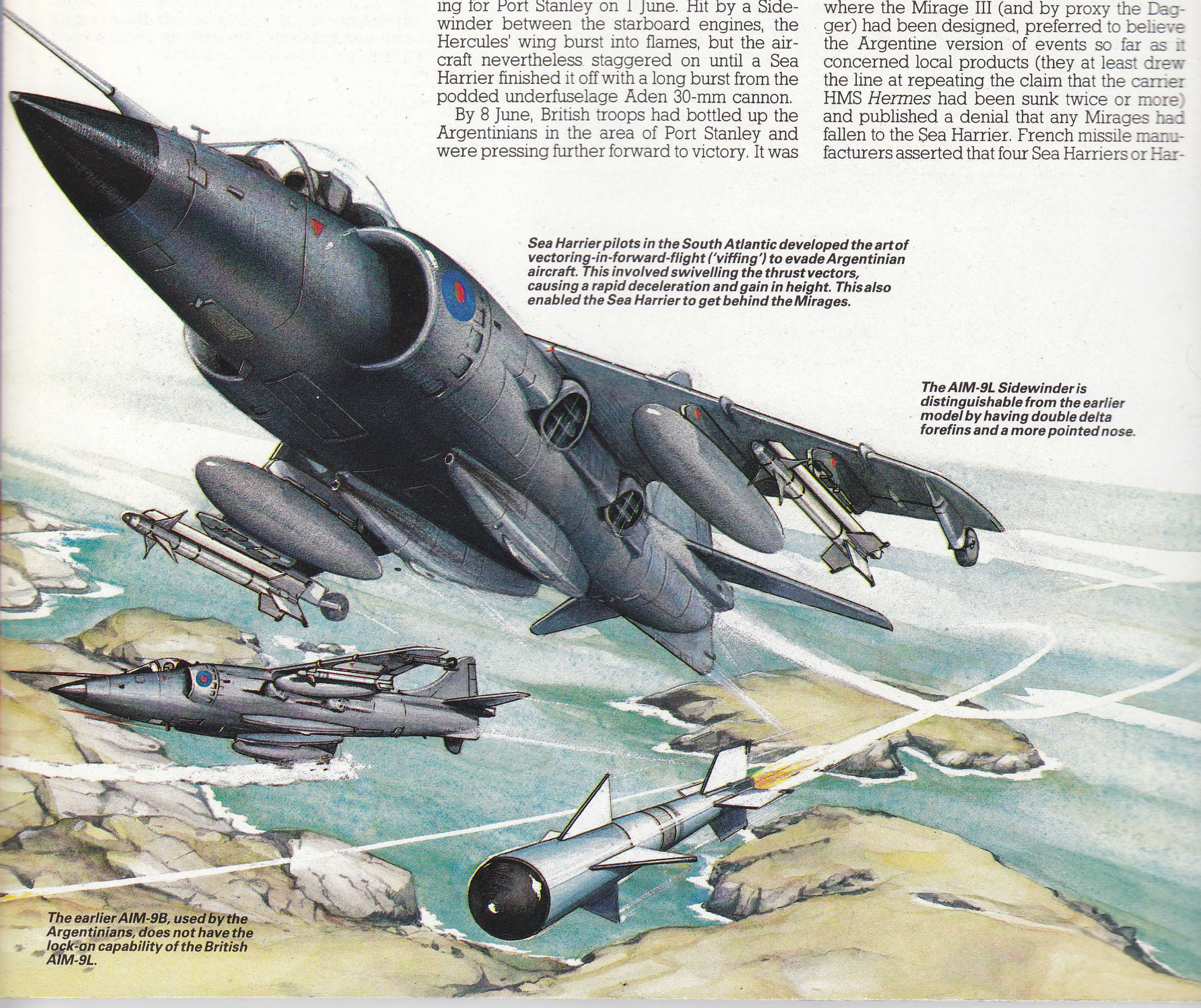
Engagements on 23 May accounted for two helicopters and a Dagger, while on the following day, two Sea Harriers fireballed three out of four Daggers which they intercepted over Pebble Island. An unusual victory, even more one-sided than those which had taken place previously, resulted from the sighting of an Argentine Lockheed Hercules transport making for Port Stanley on 1 June. Hit by a Sidewinder between the starboard engines, the Hercules' wing burst into flames, but the aircraft nevertheless staggered on until a Sea Harrier finished it off with a long burst from the podded underfuselage Aden 30-mm cannon.

By 8 June, British troops had bottled up the Argentinians in the area of Port Stanley and were pressing further forward to victory. It was on this day that the Sea Harriers undertook their final air combat in fittingly tremendous form. Diverted from a training sortie to intercept a flight of four Daggers, Flight Lieutenant Dave Morgan and Lieutenant David Smith nailed three of the intruders with Sidewinders and reported that the fourth had flown into a hill under cannon attack.

After combat performance had been examined in detail at the end of hostilities, the heavily outnumbered Sea Harrier force was credited with the destruction of 20 Argentine aircraft, all except four of them with Sidewinders, although there is particularly strong evidence to suggest that two of the three additional 'probable' claims may also be placed in the 'confirmed' category. Not one Sea Harrier was lost in air combat, and only two fell to ground fire or SAMs from a total of some 1,200 operational sorties. A further four were destroyed in accidents, principally as the result of flying in atrocious weather which would have kept any other naval aircraft below decks.

View from France

The repercussions of this spectacular achievement were felt farther afield than in South America. The aviation press in France, where the Mirage III (and by proxy the Dagger) had been designed, preferred to believe the Argentine version of events so far as it concerned local products (they at least drew the line at repeating the claim that the carrier HMS *Hermes* had been sunk twice or more) and published a denial that any Mirages had fallen to the Sea Harrier. French missile manufacturers asserted that four Sea Harriers or Har-

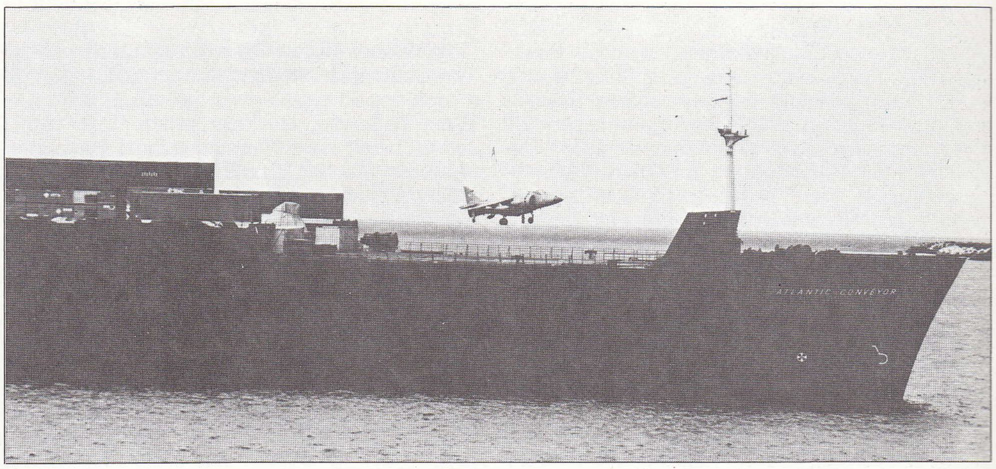


Sea Harrier pilots in the South Atlantic developed the art of vectoring-in-forward-flight ('viffing') to evade Argentinian aircraft. This involved swivelling the thrust vectors, causing a rapid deceleration and gain in height. This also enabled the Sea Harrier to get behind the Mirages.

The AIM-9L Sidewinder is distinguishable from the earlier model by having double delta forefins and a more pointed nose.

The earlier AIM-9B, used by the Argentinians, does not have the lock-on capability of the British AIM-9L.

Flight Lieutenant Dave Morgan examines the 20-mm cannon hole shot in the tail of his Sea Harrier during the first strike on Port Stanley. This was the only damage sustained on the mission.



Sea Harriers were ferried to the South Atlantic aboard the ill-fated container ship Atlantic Conveyor*. All the Sea Harriers were flown off the ship before it was hit by Exocets.*

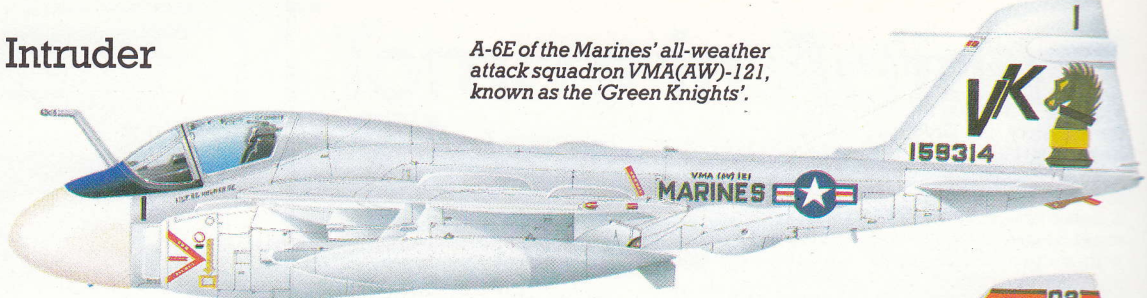
riers (instead of one) had been shot down by the Argentine Roland SAM, and provided all manner of circumstantial evidence except the vital dates. In fact, Sea Harrier pilots took some delight in baiting the Roland battery (one drawing two rounds in a single pass) and if any other aircraft were destroyed by the system, Roland must gain the dubious distinction of having shot down more friendly aircraft than those of the enemy.

The Sea Harriers' success in the South Atlantic might have been even greater had the task force possessed an airborne early warning aircraft, but even as they stand the results are impressive. Had the FAA's Mirages been capable of destroying the Sea Harrier force (instead of abandoning the effort after the first day when they discovered that their superiors had misled them over the 'toy aeroplane' opposition), fighter-bombers would have had a clear run to the task force, ensuring its inglorious retreat through excessive shipping losses. Constantly in fear of the 'Black Death' (even when none were in the vicinity) the Mirage, Dagger and Skyhawk pilots fumbled their chances in the air and brooded over the growing number of empty places at the meal-table. As soon as they encountered the Sea Harrier they knew they were beaten, and effectiveness suffered as a result; the novelty 'jump jet' had grown up into a ferocious killer.

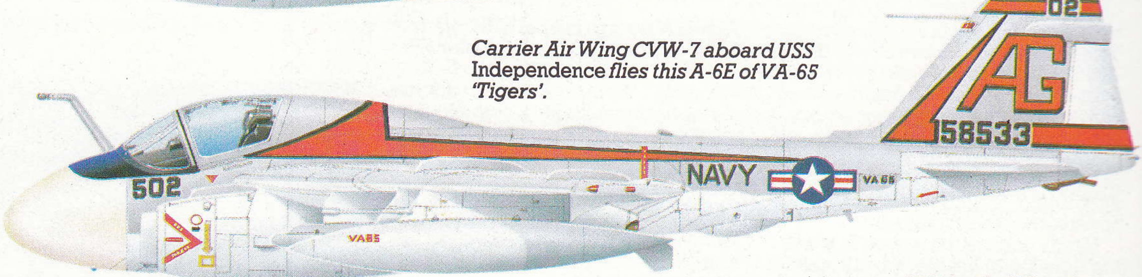
On 1 May 1982, Sea Harriers were flown against Argentinian targets. After their return, they were quickly rearmed and refuelled for further action.

USA

Grumman A-6 Intruder



A-6E of the Marines' all-weather attack squadron VMA(AW)-121, known as the 'Green Knights'.



Carrier Air Wing CVW-7 aboard USS Independence flies this A-6E of VA-65 'Tigers'.

Visually one of the less inspiring aircraft of the US Navy and US Marine Corps, the **Grumman A-6 Intruder** is nevertheless a versatile and effective all-weather attack aircraft bearing a most appropriate name. Designed in the mid-1950s primarly for nuclear attack, it was transformed in the trials stage and entered service in 1963 carrying a broad spectrum of conventional weaponry (both free-fall bombs and air-to-surface missiles), which has expanded still further with the advent of more advanced equipment.

Employed on combat missions over Vietnam, the Intruder was the sole embarked strike aircraft of its day to possess full all-weather capability and the potential for a single-pass attack, despite early unserviceability problems with its avionics. The initial models were fitted with APQ-92 search radar and APQ-88 track radar linked, with other equipment, to a Litton computer and providing the two-man crew with a picture of the scene ahead with tactical information superimposed. Basic production was of the **A-6A** variant, a few of which were modified to **A-6B** aircraft with AGM-78 Standard anti-radar missiles for defence suppression; the **A-6C** carrying a TRIM (Trails, Roads Interdiction Multisensor) pack for detection of small targets by forward-looking infra-red (FLIR) and low-light-level TV; **EA-6A** aircraft for electronic jamming; and **KA-6D** inflight-refuelling tankers. The last-mentioned has an internal hose drum unit, but retains the normal Intruder tankage and a limited (daylight) attack capability.

The current version of the Intruder, known as the **A-6E**, features an extensive avionics refit, some of the principal changes being an APQ-148 multimode radar (in place of the two earlier units) and an ASQ-133 solid-state computer. In an underfuselage turret is TRAM (Target Recognition Attack Multi-sensor) including FLIR and a laser ranger, which permits study of land surfaces and acquisition of targets marked by the aircraft's or other lasers, leading to pinpoint delivery of ordnance, whether ballistic or 'smart'. Most surviving A-6A/B/Cs have been converted to A-6Es, augmenting new production of this variant, and TRAM has been retrospectively installed in earlier A-6E models.

Specification

Grumman A-6E Intruder

Type: two-seat carrier- or shore-based all-weather attack aircraft

Powerplant: two 4218-kg (9,300-lb) thrust Pratt & Whitney J52-P-8B turbojets

Performance: maximum speed 1036 km/h (644 mph) at sea level; cruising speed 763 km/h (474 mph); service ceiling 12925 m (42,400 ft); range with maximum military load 1627 km (1,011 miles)

Weights: empty 12093 kg (26,660 lb); maximum take-off, catapult 26581 kg (58,600 lb), field 27397 kg (60,400 lb)

Dimensions: span 16.15 m (53 ft 0 in); length 16.69 m (54 ft 9 in); height 4.93 m (16 ft 2 in); wing area 49.13 m^2 (528.9 sq ft)

Armament: one underfuselage and four underwing attachment points for maximum external load of 8165 kg (18,000 lb), including a wide variety of nuclear or conventional weapons, air-launched missiles and fuel drop tanks

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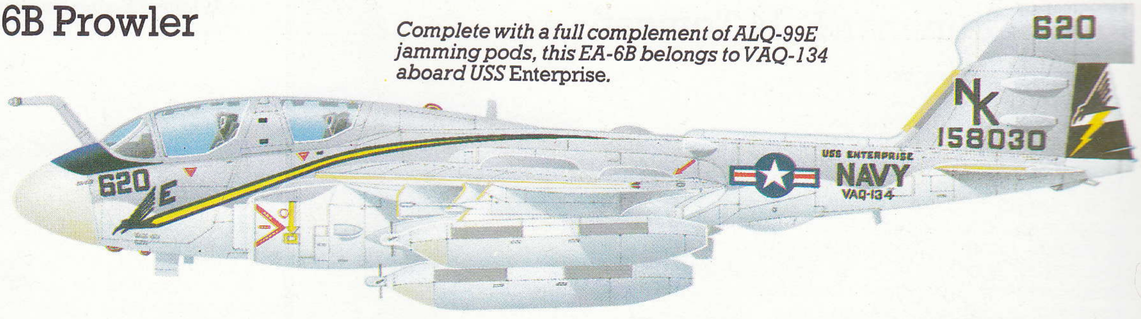
USA

Grumman EA-6B Prowler



Complete with a full complement of ALQ-99E jamming pods, this EA-6B belongs to VAQ-134 aboard USS Enterprise.

Obviously derived from the Intruder, as evidenced by retention of the basic A-6 designation, the **Grumman EA-6B Prowler** qualified for a new name by reason of its highly specialized role: electronic warfare (EW). Having identified the need for such an aircraft in the early 1960s, the US Navy and US Marine Corps took the interim step of converting a dozen A-6As to **EA-6A Intruder** standard before the prototype Prowler, with much increased capability, made its first flight in 1968.

Intended to precede or accompany naval aircraft making forays into hostile airspace and to provide them with protection against radars associated with enemy SAMs, interceptors and surveillance units, the Prowler is equipped with the powerful Cutler-Hammer ALQ-99 active jamming system. Recognition features include the fin-tip pod (containing the ALQ-99's receiver aerials) and the additional glazing for two EW operators positioned in Martin-Baker GRU-7 ejection seats immediately behind the flight crew. The active jammers are carried in up to five external pods, which may be replaced by fuel tanks when the aircraft is engaged on passive intelligence-gathering.

Sole shipboard EW aircraft of the United States, the Prowler remains in production against a requirement for 132 aircraft to be operated by 12 four-aircraft squadrons for a similar number of Naval air wings, plus 18 for the US Marines. Intended to remain in service for a further 20 years or so, the Prowler has already been subject to three modification programmes to extend its jamming repertoire and improve receivers, displays and software, the most recent being known as ICAP (Improved Capability) II. The Prowler can provide active jamming in Bands 1-2 and 4-9, covering the full range of Soviet radars, including those used in conjunction with some surface-to-surface missiles.

Specification

Grumman EA-6B Prowler

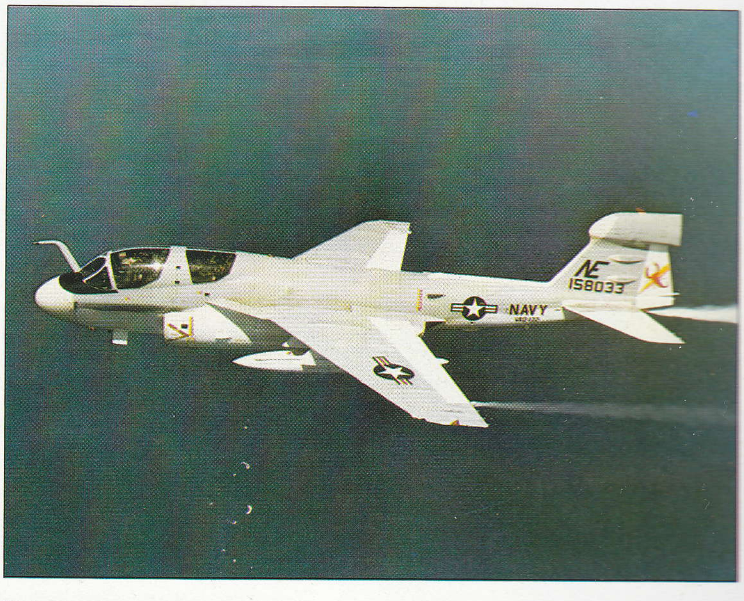
Type: four-seat carrier- or land-based advanced ECM aircraft

Powerplant: two 5080-kg (11,200-lb) thrust Pratt & Whitney J52-P-408 turbojets

Performance: (with five external pods) maximum speed 1003 km/h (623 mph); cruising speed at optimum altitude 774 km/h (481 mph); service ceiling 11580 m (38,000 ft); ferry range 3254 km (2,022 miles)

Weights: empty 14588 kg (32,162 lb); stand-off jamming configuration take-off 24703 kg (54,461 lb); ferry range configuration take-off 27492 kg (60,610 lb); maximum take-off 29484 kg (65,000 lb)

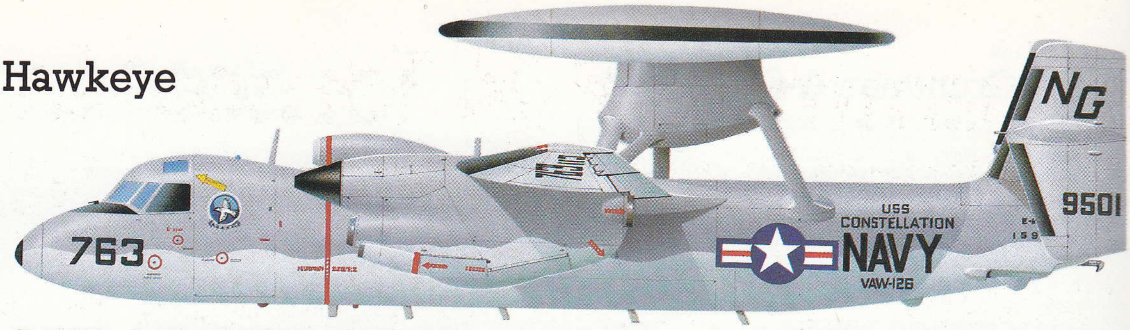
Dimensions: span 16.15 m (53 ft 0 in); length 18.11 m (59 ft 5 in). height 4.93 m (16 ft 2 in); wing area 49.13 m^2 (528.9 sq ft)



This EA-6B amply shows the modifications to the basic A-6 airframe. The lengthened nose houses an extra cockpit for the ECM operator and the tail radome contains the receiver aerials.

USA

Grumman E-2 Hawkeye



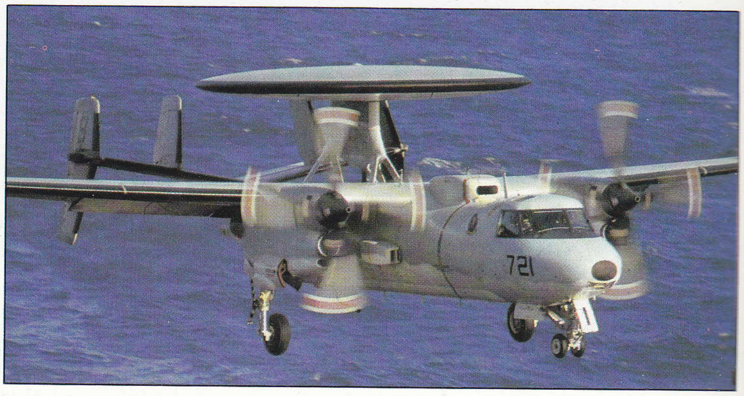
The US Navy's principal AEW platform is the Grumman E-2 Hawkeye. This is an E-2C of VAW-126, forming part of CVW-9 aboard USS Constellation.

First line of defence from air attack for the US Navy, the **Grumman E-2 Hawkeye** is a carrier-operated airborne early warning system which has been in service since 1964 and now flies with a dozen seagoing squadrons. Patrolling at 9145 m (30,000 ft) in all weathers with a crew of five (including three systems operators), the Hawkeye's principal sensor is the APA-171 antenna which is housed in a distinctive rotodome. In conjunction with the APS-125 ARPS (Advanced Radar Processing System) and an ALR-59 passive detection system, the discus-shaped scanner, turning six times each minute, can locate aircraft up to 480 km (300 miles) distant, its main concern being those attempting to infiltrate beneath the coverage of ships' radars.

Highly automated systems aboard the Hawkeye enable the aircraft to track more than 250 targets and simultneously to control in excess of 30 interceptions by friendly fighters. It can identify an object the size of a cruise missile 185 km (115 miles) distant, but is also capable of monitoring shipping and movements of vehicles on land.

Production of the **E-2A** version totalled 56, all survivors of which became **E-2B** aircraft with addition of enhanced computing facilities, whilst the present **E-2C**, which has a more reliable and easily maintained radar, is due to be manufactured until the last of 95 for the US Navy is delivered in 1987. Improvements in prospect for this version includes a TRAC-A (Total Radiation Aperture Control Antenna) for increased resistance to electronic jamming from Soviet aircraft such as the 'Backfire', and even greater radar range.

No other navies fly the Hawkeye, but small numbers are being supplied to Israel (which has already used the aircraft to direct attack missions as well as co-ordinate defence), Egypt and Japan. In addition, Spain and Singapore are negotiating procurement, whilst France may also become a customer for land-based operation.



Evident in this photograph of an E-2C is the radome, housing the APA-171 radar. The unusual four-fin tail enables the height to be kept down to that of the hangar interiors.

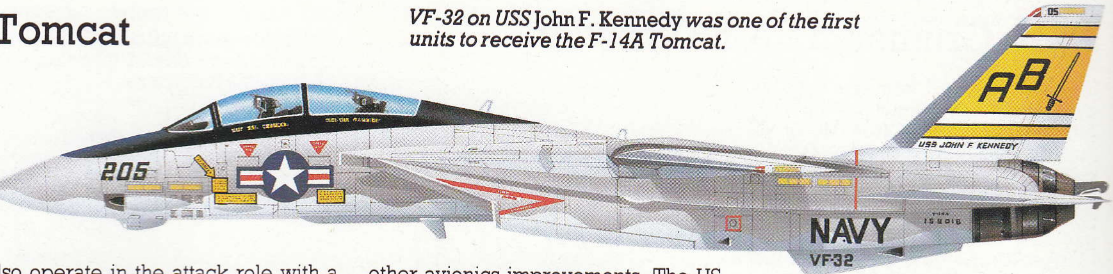
Specification
Grumman E-2C Hawkeye

Type: five-seat airborne early warning and control aircraft
Powerplant: two 4,910-eshp (3661-kW) Allison T56-A-425 turboprops
Performance: maximum speed 602 km/h (374 mph); long-range cruising speed 499 km/h (310 mph); service ceiling 9390 m (30,800 ft); endurance with maximum fuel 6 hours 6 minutes
Weights: empty 17211 kg (37,945 lb); maximum take-off 23503 kg (51,817 lb)
Dimensions: span 24.56 m (80 ft 7 in); length 17.54 m (57 ft 6¾ in); height 5.58 m (18 ft 3 in); wing area 65.03 m^2 (700.0 sq ft)

USA

Grumman F-14 Tomcat

VF-32 on USS John F. Kennedy *was one of the first units to receive the F-14A Tomcat.*



Undoubtedly the most potent interceptor to operate from an aircraft-carrier, and an equal to the best of its land-based compatriots, the **Grumman F-14 Tomcat** has the further distinction of being the only variable-geometry (VG) aircraft in naval service. Produced to an exacting specification as a substitute for the ill-fated General Dynamics/Grumman F-111B fleet-defence fighter, the Tomcat numbers among its aerodynamic refinements a unique foreplane which extends from the fixed portion of the wing leading edge to regulate changes in centre of pressure and thus obviate pitching as the wings are moved from the fully-extended 20° of sweepback to the maximum 68°.

Ordered in quantity for the US Navy, which hopes to acquire 845, the Tomcat has a remarkable differential in armament range, beginning with the M61A1 rotary cannon and progressing via the infra-red AIM-9 Sidewinder and radar-guided AIM-7 Sparrow AAMs to the 200-km (125-mile) range AIM-54A Phoenix. In conjunction with the powerful Hughes AWG-9 radar, the Phoenix has the longest 'reach' of any AAM, although the Tomcat may also operate in the attack role with a useful 6577 kg (14,500 lb) of ordnance. The **F-14A** entered service in 1972 and recently acquired a further capability through the TARPS (Tactical Air Reconnaissance Pod System), which is carried beneath the fuselage.

The aircraft's first air-to-air combat took place in August 1981 when two Libyan Sukhoi Su-22 'Fitter-Js' were shot-down by Sidewinders after they had attacked a pair of Tomcats over the Mediterranean, but it appears that the 80 aircraft supplied to Iran have seen little service in the Gulf war with Iraq. Only a few of the Iranian Tomcats are serviceable, and their AIM-54s are inoperative.

Tomcat production is now turning over to the **F-14C** version with TF30-414A versions of the TF30 turbofan, better radar resistance to jamming and other avionics improvements. The US Navy has yet to adopt the proposed **F-14D Super Tomcat** with 13154-kg (29,000-lb) thrust F110 engines and the improved AIM-54C Phoenix.

Specification
Grumman F-14A Tomcat

Type: two-seat carrier-based air-superiority fighter
Powerplant: two 9480-kg (20,900-lb) afterburning thrust Pratt & Whitney TF30-P-412 turbofans
Performance: maximum speed at height 2517 km/h (1,564 mph) or Mach 2.34; maximum speed at sea level 1470 km/h (910 mph) or Mach 1.2; initial climb rate over 9145 m (30,000 ft) per minute; service ceiling over 17070 m (56,000 ft); range (interceptor, with external fuel) about 2,000 miles (3200 km)
Weights: empty 8036 kg (39,762 lb); normal take-off 26553 kg (58,539 lb); take-off with four Sparrow AAMs 26718 kg (58,904 lb); take-off with six Phoenix AAMs 31656 kg (69,790 lb); maximum take-off 33724 kg (74,348 lb)
Dimensions: span, unswept 19.45 m (64 ft 1½ in) and swept 11.65 m (38 ft 2½ in); length 19.10 m (62 ft 8 in); height 4.88 m (16 ft 0 in); wing area 52.49 m^2 (565.0 sq ft)
Armament: one M61A1 Vulcan 20-mm multi-barrel cannon in forward fuselage with 675 rounds, four AIM-7 Sparrow or AIM-54 Phoenix air-to-air missiles under fuselage, two AIM-9 Sidewinder air-to-air missiles (or one Sidewinder plus one Phoenix or Sparrow) under each wing glove box, tactical reconnaissance pod containing cameras and electro-optical sensors, or up to 6577 kg (14,500 lb) of bombs, missiles or other weapons.

A Tomcat about to 'trap' aboard its 'homeplate'. The striped arrester hook is ready to engage no. 1 wire and the wings are set in the minimum sweep position of 20° at the leading edge. The wide-track undercarriage makes carrier landings easier.

Grumman F-14 Tomcat in Action

One might expect that designing a warplane to operate from a carrier would inhibit and compromise capabilities. Often it does; but not in the case of the Tomcat. It is undoubtedly the finest and most capable naval air defence fighter in the skies today.

A trigger-happy Libyan pilot sparked off a brief engagement on 19 August 1981 with two examples of the most formidable fighter in today's sky: the Grumman F-14A Tomcat. As described below, this engagement was one of the very few genuine air combats of the period between the Vietnam and the Falklands wars; but even without it the US Navy had little doubt the F-14 would perform exceptionally well.

Grumman had been the prime contractor on the F-111B swing-wing fighter which, troubled by deep technical shortcomings, ground to a halt in April 1968. The US Navy replaced it with a new VFX design contest which Grumman won with its Model 303, which became the F-14A. The prototype flew on 21 December 1970.

The Tomcat was a pioneer of the concept of two seats, two engines and two vertical tails, and it also retained variable-sweep swing-wings for optimized performance under widely differing speeds, aircraft weights and altitudes.

Most important of all, the Tomcat set a new high standard in its avionics and armament. The Hughes AWG-9 radar fire-control system has unrivalled capability of detecting targets at far beyond visual range, out to 120 km (75 miles) for fighters and as much as 315 km (195 miles) for the largest aircraft. It can continuously track 24 targets, and select from these any six (at widely differing heights, ranges, speeds and directions of flight) and simultaneously fire on all six.

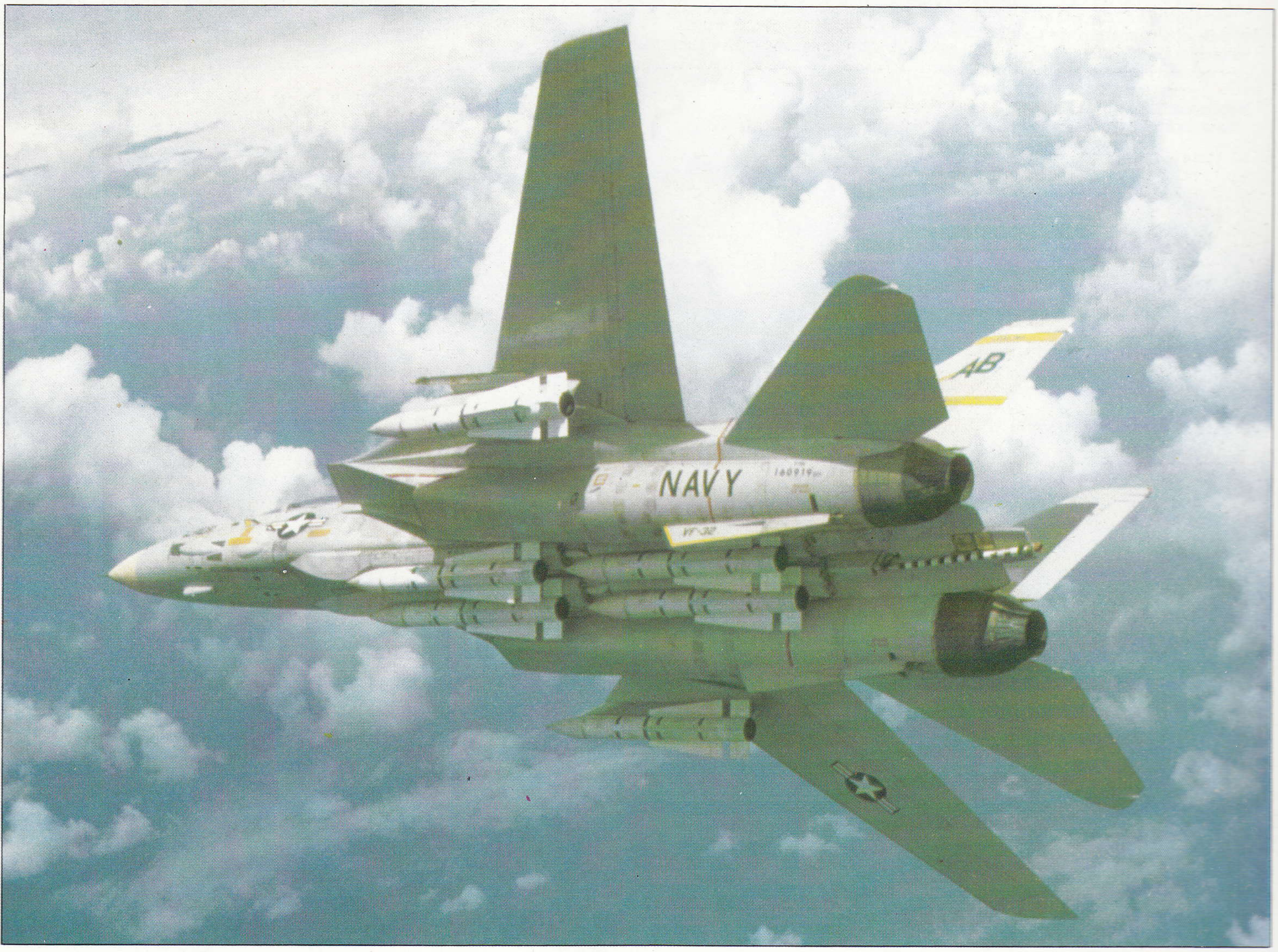
Weapon fits

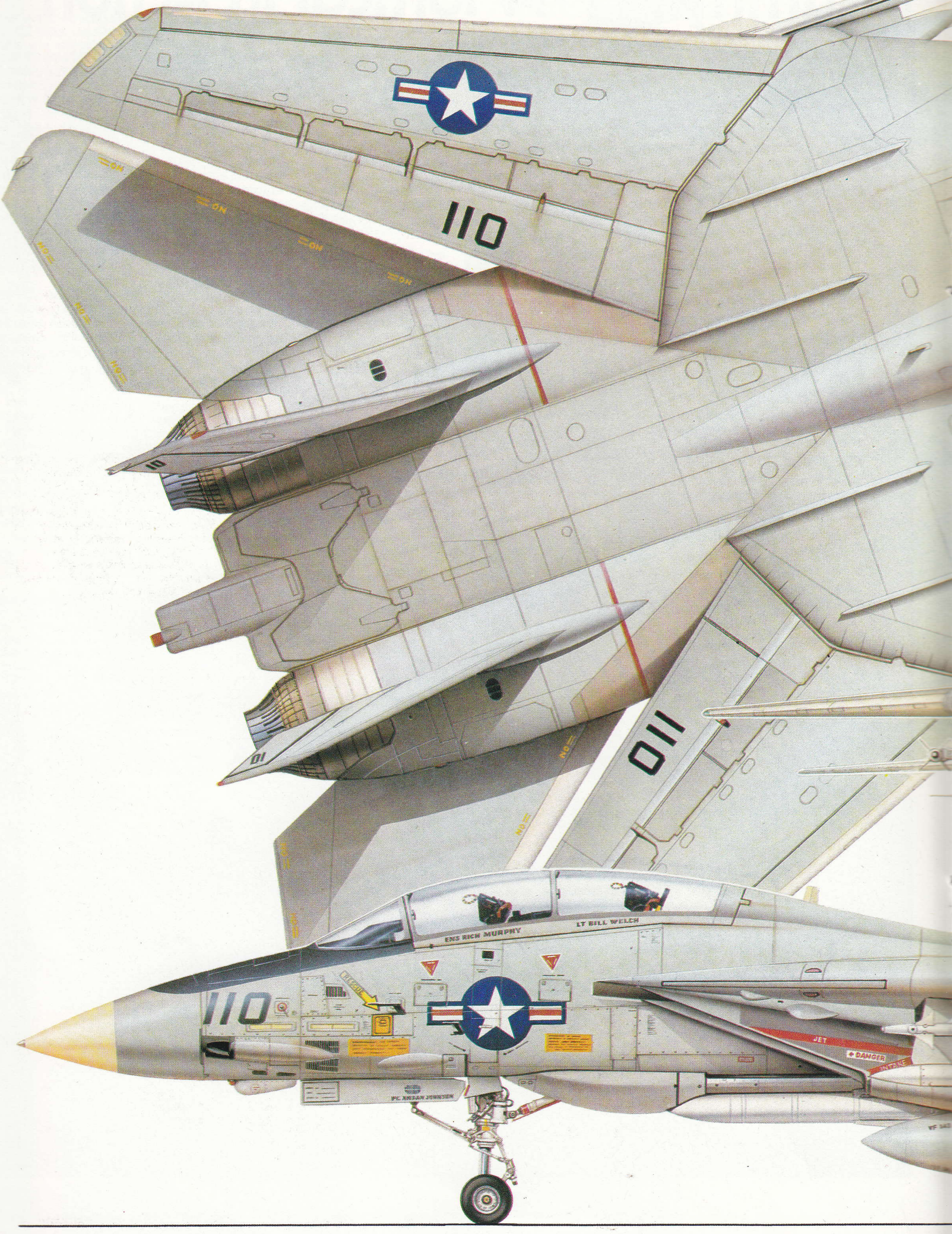
The flight crew, comprising a pilot (aircraft commander) and NFO (naval flight officer, who from the back seat manages the avionics and interception/navigation), enjoy the unique choice of four species of air-to-air weapon (and the Tomcat can also carry many kinds of surface-attack weapon, though it is not often called upon to do so, because its primary missions are anti-air): for the longest ranges the Hughes AIM-54 Phoenix missile has no equal; the medium-range radar guided missile is the AIM-7 Sparrow; for closer-range interceptions the AIM-9 Sidewinder is used; and at short ranges the pilot can use the onboard M61A1 gun, with 675 rounds.

Apart from the fact that its ratio of thrust to gross weight is low for a modern fighter (at maximum weight of 33724 kg/74,348 lb the F-14A in maximum afterburner power has a thrust: weight ratio of only 0.55:1) the Tomcat has no shortcomings. It is especially well provided for in its EW (electronic warfare) suite, with ALR-45 radar warning receiver boxes fed by small antennae (aerials) near the tips of both tailplanes, a complete ALQ-100 deception countermeasures system, and an ALE-39 installation between the jetpipes for ejecting various EW dispensed payloads such as chaff cartridges, IR (infra-red) flares to decoy enemy heat-seeking missiles, and even small radio-emitting jammers.

Deployment of the F-14A with the US Navy carrier air groups began in October 1972. Originally they were to have 469 aircraft, then 722, then (following massive inflationary increases in price, and heavy losses by Grumman in making the F-14) this was cut back to 313. Gradually the total grew again to 497, including the 12

The Tomcat is unrivalled in long-range kill capability when armed with the Hughes AIM-54 Phoenix air-to-air missile; this Tomcat of VF-32 carries eight missiles under the fuselage and on the wing pylons. The aircraft's 'beaver' tail is clearly visible, separating the tailpipes.

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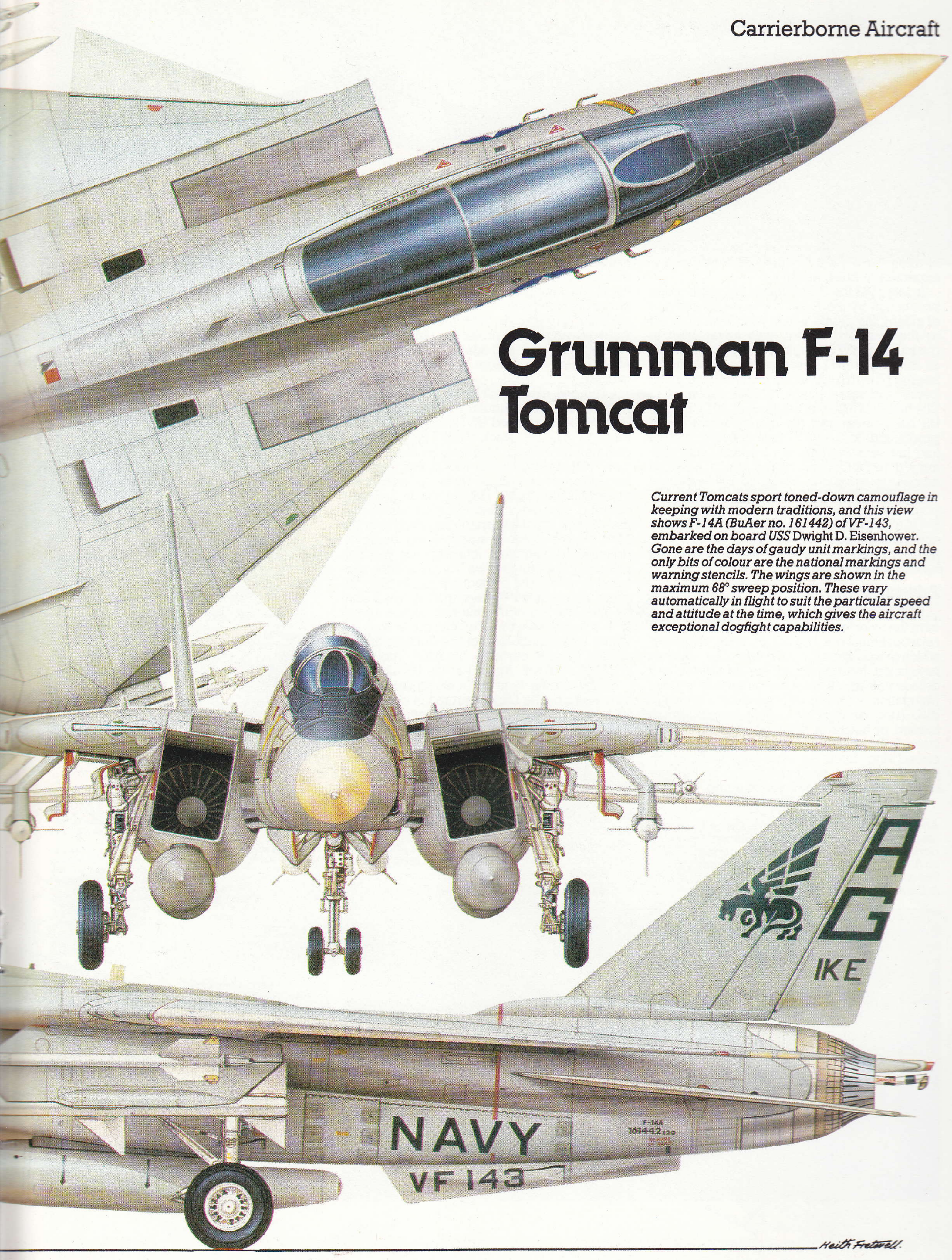
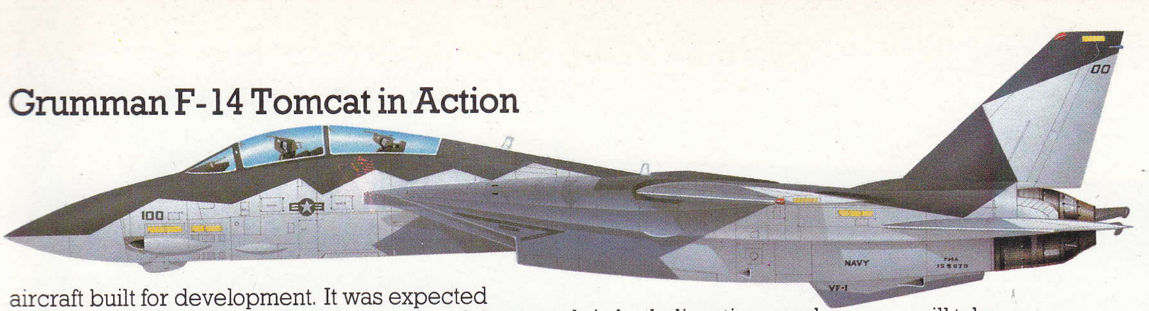
Grumman F-14 Tomcat



Current Tomcats sport toned-down camouflage in keeping with modern traditions, and this view shows F-14A (BuAer no. 161442) of VF-143, embarked on board USS Dwight D. Eisenhower. *Gone are the days of gaudy unit markings, and the only bits of colour are the national markings and warning stencils. The wings are shown in the maximum 68° sweep position. These vary automatically in flight to suit the particular speed and attitude at the time, which gives the aircraft exceptional dogfight capabilities.*



Left: An F-14A of VF-1 on detachment to VX-4 evaluation squadron at Point Mugu. The 'splinter' camouflage suggests that the aircraft was being used to simulate an enemy aircraft.

aircraft built for development. It was expected that the rather lighter and less-powerful McDonnell Douglas F/A-18A Hornet would act as a replacement, but in fact this aircraft turned out to cost even more than the F-14A, at around $36 million for each aircraft compared with $31 million (in 1983, but in 1977 currency values), so the F-14 is being kept in production at the rate of about 24 a year. By the 1990s the total is expected to finish at 845.

In late 1983 the F-14A was at last replaced in production by the F-14C. Because of shortage of money the F-14B, which had been planned as the standard model, was never built in quantity. The TF30 engine, basically the same as that of the F-111, was intended only as an interim powerplant, and in the F-14B the much better and more powerful F401 replaced it. The first F-14B flew in September 1973, but the US Navy never had the money to put it into production, so the TF30 flies in every Tomcat and has caused years of problems, with prolonged technical difficulties which have on numerous occasions hazarded or destroyed the aircraft. The TF30 has been 'fixed' by various changes, and the latest model is the TF30-P-414A with new first-stage compressor blades and an even stronger casing to ensure that, should the engine blow up, the blades would be contained inside it.

Advanced avionics

More important advances in the F-14C concern the avionics. Both pilot and NFO have new reprogrammable digital cockpit displays, which greatly ease the problems of all-weather navigation, interception of hostile aircraft and delivery of various weapons on surface targets. Navigation is further improved by a futuristic RLG (ring laser gyro) inertial system, which instead of having a spinning gyro rotor uses laser light endlessly rotating round an enclosed ring. Even the smallest rotation of the aircraft causes a slight difference in the time taken for the light to go round the ring (the light travels in both directions, and one way will take longer and the other way shorter). The time differences are fed to a computer and out comes precise information on the aircraft's position! Even the computer is new, and other equipment includes a TCS (TV camera set) which can identify aircraft by type at distances many times greater than human eyes could even see them, an ALR threat-warning system, the JTIDS (joint tactical information distribution system) which by the 1990s will link all friendly air/land/sea vehicles, and the new ALQ-165 ASPJ (advanced self-protection jammer) which will protect the F-14C against all kinds of hostile missiles, fired from the air or from the ground.

Of course, the aircraft involved in the clash in August 1981 were regular F-14As. They came from one of the famed US Navy fighter squadrons, VF-41, the 'Black Aces'. Flown by the commanding officer, Commander Henry Kleeman, with Lieutenant L. Muczynski as wingman, the two aircraft in question were catapulted off the mighty USS *Nimitz* in the early morning, after a day when many Libyan aircraft had broken into the airspace reserved over the Mediterranean for a missile-firing exercise, despite the standard international warning procedures. Soon the two Tomcats were vectored on to a radar contact coming in from the south. Almost head-on they spotted two Sukhoi Su-22 'Fitter-J' aircraft. This is no sort of aircraft with which to take on a Tomcat, but as they got within firing range one of the Sukhois fired a missile (almost certainly an AA-2 'Atoll', but possibly an AA-8 'Aphid') at the US aircraft.

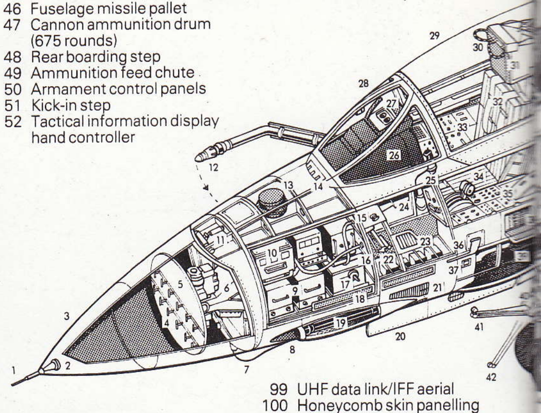
Both Tomcats went into a maximum-rate left turn, keeping the Libyan aircraft in sight. Each took on one of the Libyan machines, and within seconds Muczynski had achieved good firing parameters on his 'Fitter'. He let go a Sidewinder, and it went straight up the tailpipe of the target aircraft and exploded. Kleeman held off while his 'Fitter' approached the sun and crossed it, because Sidewinders perform badly with the sun beyond the target (for obvious reasons, because the sun presents a better heat source than the target). When the Libyan aircraft was well beyond the sun Kleeman fired his Sidewinder: this too was a direct hit, and within five seconds the Libyan pilot ejected.

An F-14A on the 'cat' of USS John F. Kennedy *with its leading edge slats fully deployed for maximum lift during the launch. The missile on the wing pylon is an AIM-9L Sidewinder for closer work than the Phoenix. A Vought Corsair II of VF-32 waits its turn in the background.*

Right: The Tomcat demonstrates its usual weapon, the AIM-54 Phoenix. This missile can hit an enemy aircraft at a range of up to 200 km (124 miles).

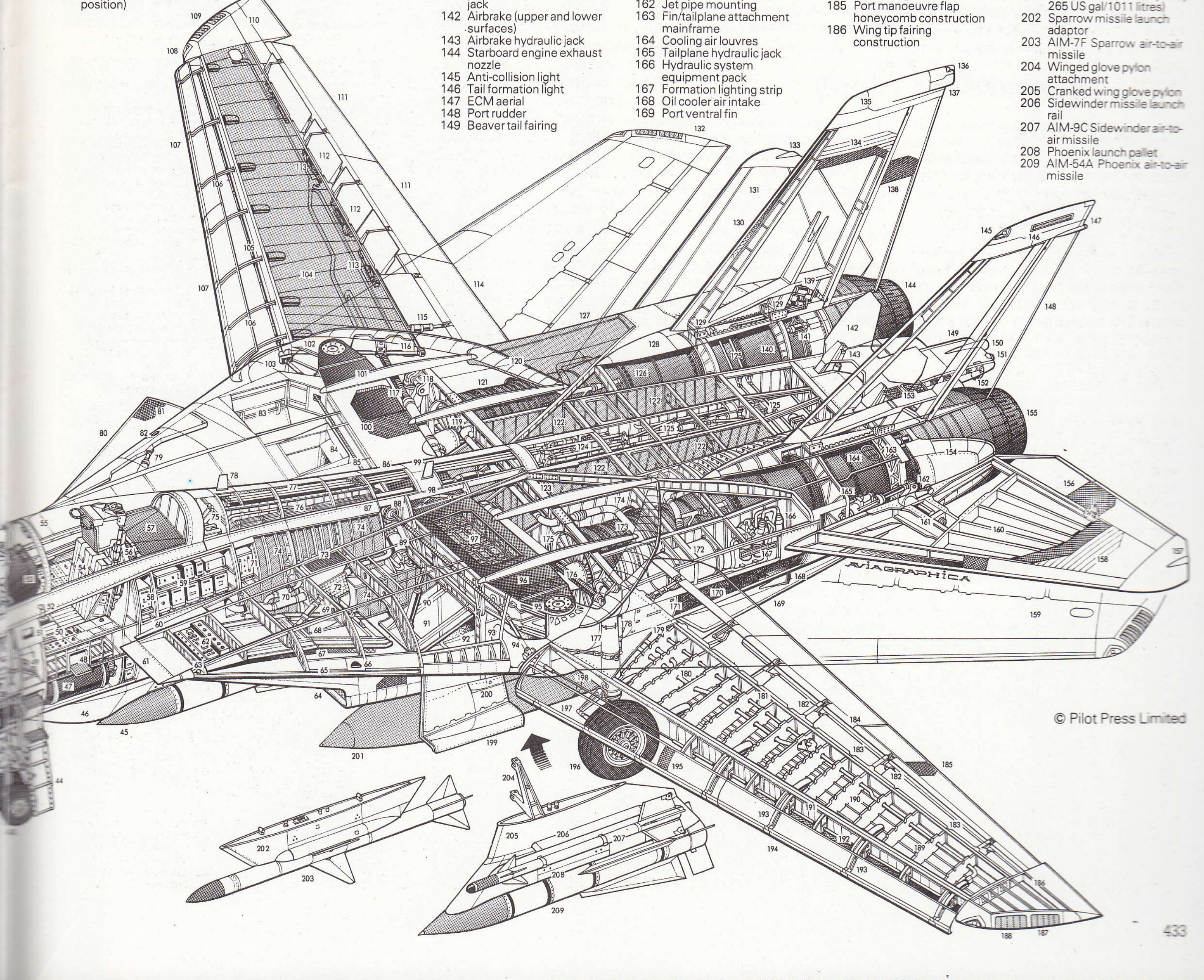
Grumman F-14A Tomcat cutaway drawing key

1 Pitot tube
2 Radar target horn
3 Glassfibre radome
4 IFF aerial array
5 Hughes AWG-9 flat plate scanner
6 Scanner tracking mechanism
7 Ventral ALQ-100 antenna
8 Gun muzzle blast trough
9 Radar electronics equipment bay
10 AN/ASN-92 inertial navigation unit
11 Radome hinge
12 In-flight refuelling probe (extended)
13 ADF aerial
14 Windscreen rain removal air duct
15 Temperature probe
16 Cockpit front pressure bulkhead
17 Angle of attack transmitter
18 Formation lighting strip
19 Cannon barrels
20 Nosewheel doors
21 Gun gas vents
22 Rudder pedals
23 Cockpit pressurization valve
24 Navigation radar display
25 Control column
26 Instrument panel shroud
27 Kaiser AN/ANG-12 head-up display
28 Windscreen panels
29 Cockpit canopy cover
30 Face blind seat firing handle
31 Ejection seat headrest
32 Pilot's Martin-Baker GRU-7A ejection seat
33 Starboard side console panel
34 Engine throttle levers
35 Port side console panel
36 Pitot static head
37 Canopy emergency release handle
38 Fold out step
39 M61A1 Vulcan 20-mm six-barrel rotary cannon
40 Nose undercarriage leg strut
41 Catapult strop link
42 Catapult strop, launch position
43 Twin nosewheels
44 Folding boarding ladder
45 Hughes AIM-54A Phoenix air-to-air missile (6)
46 Fuselage missile pallet
47 Cannon ammunition drum (675 rounds)
48 Rear boarding step
49 Ammunition feed chute
50 Armament control panels
51 Kick-in step
52 Tactical information display hand controller
53 Naval Flight Officer's instrument console
54 NFO's ejection seat
55 Starboard intake lip
56 Ejection seat launch rails
57 Cockpit aft decking
58 Electrical system controller
59 Rear radio and electronics equipment bay
60 Boundary layer bleed air duct
61 Port engine intake bay
62 Electrical system relay controls
63 Glove vane pivot
64 Port air intake
65 Glove vane housing
66 Navigation light
67 Variable area intake ramp doors
68 Cooling system boundary layer duct ram air intake
69 Intake ramp door hydraulic jacks
70 Air system piping
71 Air data computer
72 Heat exchanger
73 Heat exchanger exhaust duct
74 Forward fuselage fuel tanks
75 Canopy hinge point
76 Electrical and control system ducting
77 Control rod runs
78 UHF/TACAN aerial
79 Glove vane hydraulic jack
80 Starboard glove vane, extended
81 Honeycomb panel construction
82 Navigation light
83 Main undercarriage wheel bay
84 Starboard intake duct spill door
85 Wing slat/flap flexible drive shaft
86 Dorsal spine fairing
87 Fuselage top longeron
88 Central flap/slat drive
89 Emergency hydraulic generator
90 Bypass door hydraulic jack
91 Intake bypass door
92 Port intake ducting
93 Wing glove sealing horn
94 Flap/slat telescopic drive shaft
95 Port wing pivot bearing
96 Wing pivot carry-through (electron beam welded)
97 Wing pivot box integral fuel tank
98 Fuselage longeron/pivot box attachment joint
99 UHF data link/IFF aerial
100 Honeycomb skin panelling
101 Wing glove stiffeners/dorsal fences
102 Starboard wing pivot bearing



1986
NAVY
209

103 Slat/flap drive shaft gearbox
104 Starboard wing integral fuel tank (total internal fuel capacity 2,364 US gal/8951 litres)
105 Leading edge slat drive shaft
106 Slat guide rails
107 Starboard leading edge slat segments (open)
108 Starboard navigation light
109 Low-voltage formation lighting
110 Wing tip fairing
111 Outboard manoeuvre flap segments (down position)
112 Port roll control spoilers
113 Spoiler hydraulic jacks
114 Inboard high lift flap (down position)
115 Inboard flap hydraulic jack
116 Manoeuvre flap drive shaft
117 Variable wing sweep screw jack
118 Starboard main undercarriage pivot fixing
119 Starboard engine compressor face
120 Wing glove sealing plates
121 Pratt & Whitney TF30-P-412 afterburning turbofan
122 Rear fuselage fuel tanks
123 Fuselage longeron joint
124 Control system artificial feel units
125 Tailplane control rods
126 Starboard engine bay
127 Wing glove pneumatic seal
128 Fin root fairing
129 Fin spar attachment joints
130 Starboard fin leading edge
131 Starboard all-moving tailplane
132 Starboard wing (fully swept position)
133 AN/ALR-45 tail warning radar antenna
134 Fin aluminium honeycomb skin panel construction
135 Fin-tip aerial fairing
136 Tail navigation light
137 Electronic counter-measures antenna (ECM)
138 Rudder honeycomb construction
139 Rudder hydraulic jack
140 Afterburner ducting
141 Variable area nozzle control jack
142 Airbrake (upper and lower surfaces)
143 Airbrake hydraulic jack
144 Starboard engine exhaust nozzle
145 Anti-collision light
146 Tail formation light
147 ECM aerial
148 Port rudder
149 Beaver tail fairing
150 Fuel jettison pipe
151 ECM antenna
152 Deck arrester hook (stowed position)
153 AN/ALE-29A chaff and flare dispensers
154 Nozzle shroud sealing flaps
155 Port convergent/divergent afterburner exhaust nozzle
156 Tailplane honeycomb construction
157 AN/ALR-45(V) tail warning antenna
158 Tailplane boron fibre skin panels
159 Port wing (fully swept position)
160 All-moving tailplane construction
161 Tailplane pivot fixing
162 Jet pipe mounting
163 Fin/tailplane attachment mainframe
164 Cooling air louvres
165 Tailplane hydraulic jack
166 Hydraulic system equipment pack
167 Formation lighting strip
168 Oil cooler air intake
169 Port ventral fin
170 Engine accessory compartment
171 Ventral engine access doors
172 Hydraulic reservoir
173 Bleed air ducting
174 Port engine bay
175 Intake compressor face
176 Wing variable sweep screw jack
177 Main undercarriage leg strut
178 Hydraulic retraction jack
179 Wing skin panel
180 Fuel system piping
181 Rear spar
182 Flap hinge brackets
183 Port roll control spoilers
184 Flap leading edge eyebrow seal fairing
185 Port manoeuvre flap honeycomb construction
186 Wing tip fairing construction
187 Low-voltage formation lighting
188 Port navigation light
189 Wing rib construction
190 Port wing integral fuel tank
191 Front spar
192 Leading edge rib construction
193 Slat guide rails
194 Port leading edge slat segments, open
195 Slat honeycomb construction
196 Port mainwheel
197 Torque scissor links
198 Main undercarriage front bracing strut
199 Mainwheel well door
200 Ventral pylon attachment
201 External fuel tank (capacity 265 US gal/1011 litres)
202 Sparrow missile launch adaptor
203 AIM-7F Sparrow air-to-air missile
204 Winged glove pylon attachment
205 Cranked wing glove pylon
206 Sidewinder missile launch rail
207 AIM-9C Sidewinder air-to-air missile
208 Phoenix launch pallet
209 AIM-54A Phoenix air-to-air missile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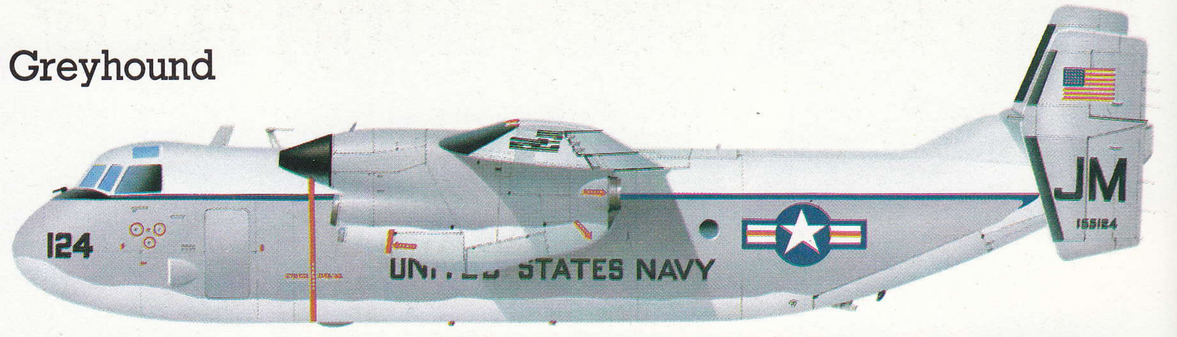
USA

Grumman C-2 Greyhound



The C-2 Greyhound has operated in the COD (carrier onboard delivery) role since 1964. Originally developed from the E-2 Hawkeye, the C-2 features a much deeper fuselage for cargo.

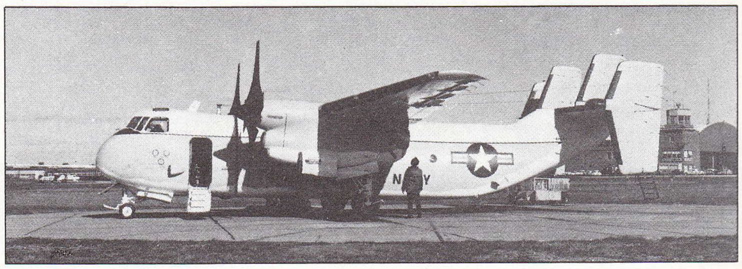
COD (carrier on-board delivery) is the prime function of the **Grumman C-2A Greyhound**, and only the US Navy possesses a specially-built aircraft for this role. Typical COD missions between distant carriers (or more likely from shore to ship) involve transfer of personnel and urgently-needed equipment and supplies, ensuring maximum operability of embarked combat forces. With the Greyhound, the cargo can be up to 28 passengers; 12 stretchers and attendants; or 4536 kg (10,000 lb) of freight, increasing to 6804 kg (15,000 lb) for land operation. As such, the aircraft represents a faster, more efficient method of transport than the commando-type helicopter which most navies have to use for this work.

Obviously a close relation to the Hawkeye, the Greyhound entered service in 1966, differing from their early-warning compatriots in having a bigger fuselage with rear-loading doors and, of course, no rotodome. Production totalled 19 aircraft based on the E-2A, of which most remain in use with land-based squadrons at locations as far apart as Japan and Italy. The C-2A has all-weather capability and provision for catapult take-offs and arrested landings.

Considerable expansion of the COD force, involving replacement of the veteran Grumman C-1 Trader, will begin with delivery in January 1985 of the first of a further 39 Greyhounds from relaunched production. Though still known as C-2As, the new aircraft will parallel the current E-2C through installation of uprated engines and avionics, plus better protection from corrosion. Passenger comfort is also to receive attention, whilst an APU auxiliary power unit) will give a measure of autonomy when operating into poorly-equipped airfields.

Specification

Grumman C-2A Greyhound
Type: two-crew on-board delivery aircraft
Powerplant: two 4,912-ehp (3663-kW) Allison T56-A-425 turboprops
Performance: maximum speed at optimum altitude 636 km/h (395 mph); cruising speed 482 km/h (299 mph); service ceiling 10210 m (33,500 ft); ferry range 2889 km (1,795 miles)
Weights: empty 14131 kg (31,154 lb); maximum take-off 24654 kg (54,354 lb)
Dimensions: span 24.56 m (80 ft 7 in); length 17.27 m (56 ft 8 in); height 5.16 m (16 ft 11 in); wing area 65.03 m^2 (700.0 sq ft)



The lifeline of the fleet are the 'CODfish'. This duty is performed almost exclusively by the Greyhound, being able to carry substantial loads from the deck of a carrier.

USA

Lockheed S-3 Viking

An airborne exercise in squeezing a quart into a pint pot (as emphasized by its dumpy appearance) the **Lockheed S-3A Viking** undertakes from aircraft-carriers the tasks performed by much larger land-based aircraft such as the Lockheed P-3 Orion and BAe Nimrod MR.Mk 2. Tightly packed with sophisticated electronics and their associated sensors, the Viking is the sole fixed-wing ASW (anti-submarine warfare) patroller of the US Navy's embarked air fleet, and though some allied navies have cast covetous glances in its direction, none has been able to afford its high cost.

Though bearing a Lockheed nametag, the Viking was produced in close collaboration with LTV which, in view of its greater experience with carrier-based aircraft, undertook design and construction of several major components. At the heart of the Viking is a Sperry-Univac digital computer for high-speed processing of information from radar, forward-looking infra-red (FLIR), the retractable MAD (magnetic anomaly detector) tailboom and ESM. With four crew, including two operators in the fuselage, Vikings carry a wide range of offensive armament, both internally and externally. The 179 production aircraft delivered from 1974 onwards equip 11 front-line squadrons, plus a training unit.

An updating and modification procedure known as WSIP (Weapon System Improvement Program) will see 160 of these converted to **S-3B** standard from 1987 onwards, with better acoustic processing, expanded ESM coverage, increased radar-processing capabilities, new sonobuoy receiver system and provision for Harpoon anti-ship missiles. A modified pitch control is to provide easier handling, and changes will be made to the hydraulic systems. Demonstrator versions have also been produced of the **US-3A** carrier transport and **KS-3A** inflight-refuelling tanker, but these have yet to receive production orders.

Specification

Lockheed S-3A Viking
Type: four-seat carrier-based patrol/attack aircraft
Powerplant: two 4207-kg (9,275-lb) thrust General Electric TF34-GE-2 turbofans
Performance: maximum cruising speed 686 km/h (426 mph); loiter speed 296 km/h (184 mph); service ceiling more than 10670 m (35,000 ft); combat range more than 3701 km (2,300 miles)
Weights: empty 12088 kg (26,650 lb); normal ASW mission take-off 19278 kg (42,500 lb)
Dimensions: span 20.93 m (68 ft 8 in); length 16.26 m (53 ft 4 in); height 6.93 m (22 ft 9 in); wing area 55.55 m^2 (598.0 sq ft)
Armament: weapons including bombs, depth-bombs, mines or torpedoes up to 907 kg (2,000 lb) in internal weapons bay, plus cluster-bombs, flare-launchers or auxiliary fuel tanks on underwing pylons

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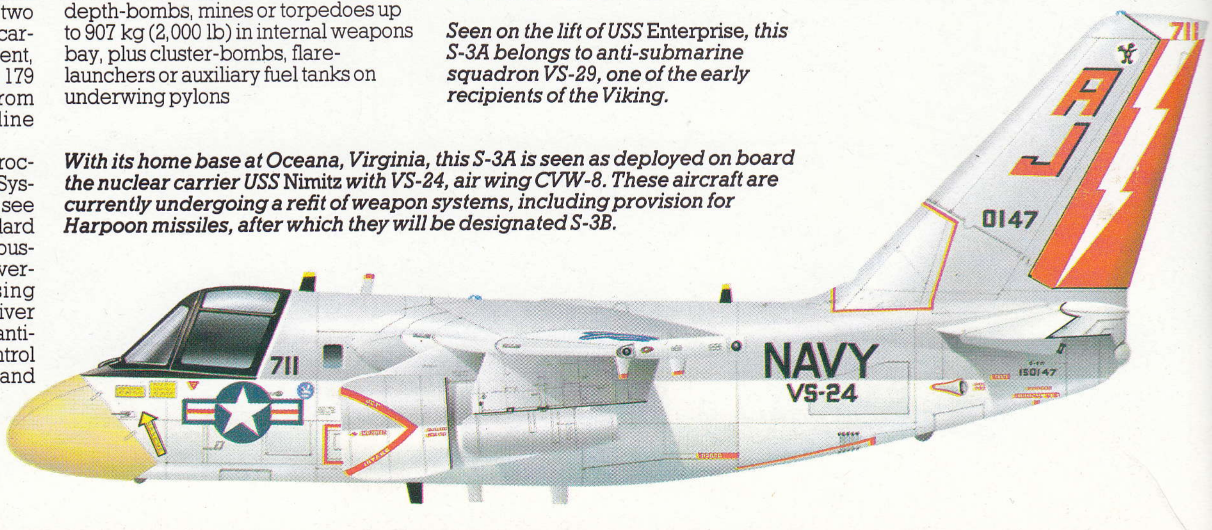
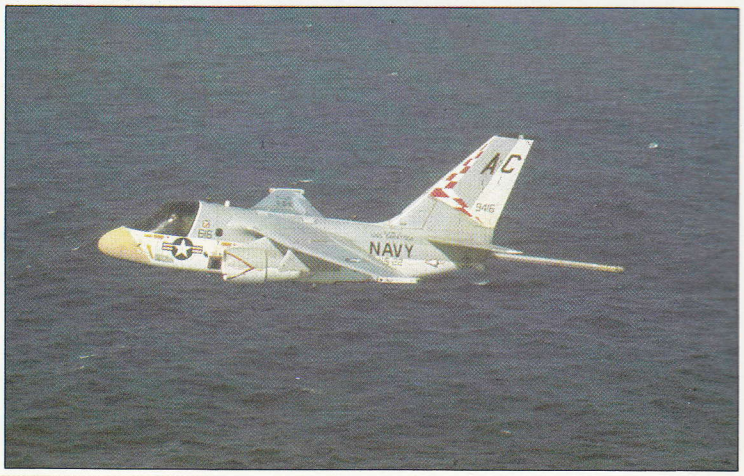
VS-29

Seen on the lift of USS Enterprise, *this S-3A belongs to anti-submarine squadron VS-29, one of the early recipients of the Viking.*



With its home base at Oceana, Virginia, this S-3A is seen as deployed on board the nuclear carrier USS Nimitz *with VS-24, air wing CVW-8. These aircraft are currently undergoing a refit of weapon systems, including provision for Harpoon missiles, after which they will be designated S-3B.*

Carrier Fixed-Wing ASW



Lockheed S-3A Viking of VS-22 from USS* Saratoga *displays its retractable 'sting', which carries MAD (magnetic anomaly detection) gear. This has to be extended to avoid interference from the aircraft.

Though the helicopter is an excellent vehicle for ASW (anti-submarine warfare), the fixed-wing aeroplane can carry heavier loads both farther and faster. Thus, anyone lucky enough to possess giant aircraft-carriers will equip them with ASW aircraft.

Back in the 1950s it was difficult to make one aeroplane, small enough to fold into the space limitations of a carrier, fly both the hunter and the killer missions. The hunter mission demands the carriage of an impressive set of ASW sensors: radar, MAD (magnetic anomaly detection) and acoustic systems such as sonobuoys. The killer mission obviously demands the carriage of effective A/S weapons, such as torpedoes or depth bombs.

Radar cannot see things under water, but modern maritime radars are specially designed to spot even the small tip of a submarine periscope or snort mast above the wave-tossed surface of the ocean. (The waves, incidentally, can pose severe problems because of their movement, and the possible high speed of the reflective spray blown from their crests.) MAD gear is designed to sense the presence of large masses of metal, such as a submarine, by measuring the distortion they cause to the Earth's magnetic field. This distortion is unaffected by water, so it can detect a submarine under the water as well as on the surface. The MAD gear is mounted as far as possible from the metal of the aircraft, and is either towed on a wire or mounted on a long boom projecting behind the tail.

Sonobuoy reconnaissance

Sonobuoys use high-frequency sound waves, just like underwater radar. Passive buoys merely float in the water, listening with highly sensitive 'ears' to the noise made by the water flowing past an enemy submarine, and to the throbbing noise of its screw. Active buoys send out intense sound pulses and listen for any reflections. Should a submarine be near, its hull will reflect the sound waves, and the latest buoys can give an indication of range and direction or depth. Ideally the ASW aircraft drops a string of sonobuoys to form a pattern beneath which the enemy submarine is expected to pass. Then its future position can be pinpointed accurately enough for even a free-fall depth charge to have a good chance of destroying it.

Of course, controlling a complete attack is no easy task. There may be several aircraft and possibly surface ships all going after one 'contact', and modern nuclear submarines can dive to several hundred metres (certainly over 300 m (985 ft) depth and run for an almost unlimited time at speeds as high as 40 kts (74 km/h/46 mph). Powerful computers are used to handle all the information and guide aircraft to the correct weapon launch point. By far the most common weapon used is the A/S torpedo, which homes automatically on its quarry.

The first aircraft able to fly the combined hunter/killer mission was the Grumman S-2 Tracker. Today this has been replaced in the US Navy by the Lockheed S-3 Viking, roughly the same size but with much higher performance from twin turbofan engines. The crew of four riding in the nose comprise the pilot, co-pilot, tactical operator (Tacco) and acoustic sensor operator (Senso). The Viking packs into a very small volume an advanced radar, IR (infra-red) sensor, MAD on a long retractable boom, a comprehensive range of sonobuoys and also complete ESM (electronic surveillance measures) receivers for sensing enemy radio and radar emissions.

Every US Navy carrier air group has one S-3A squadron. Of 187 built, some 160 still in combat service are likely to be updated to S-3B standard with improved acoustic processing, better ESM and many other advances including the ability to launch long-range Harpoon anti-ship missiles from the underwing pylons.

Launching from USS* Enterprise*'s starboard catapult, the S-3 uses its high-bypass ratio turbofan engines. These are fuel-efficient and give the S-3 an impressive and useful range of 3700 km (2,300 miles). At loiter speeds of as little as 300 km/h (186 mph), missions can theoretically reach 12 hours.

US Carrier Air Wings

A US carrier air wing in full battle order is the mightiest concentration of air power in all creation. Structured to carry out a full range of missions, it outclasses most of the world's air forces.

Since World War II the US Navy's fleet carriers (also called attack carriers) have embarked an integrated group of aircraft known as an Air Wing. In the US Navy a carrier is a CV, and its air wing is prefixed by CVW. The number of CVWs has varied in recent years from 12 to 14, but is in late 1983 13, all embarked in giant super-carriers which began with CV-59 *Forrestal* and in 1983 had reached CV-70 *Carl Vinson*, with CV-71 *Theodore Roosevelt* soon to commission. After much argument over the cost-effectiveness of these colossal ships, each with some 6,300 men on board, $6,841 million was voted in 1983 for CV-72 and CV-73.

The total carrier force is organized into eight CarGrus (carrier groups), with headquarters at San Diego, Naples, Alameda (San Francisco), Norfolk (Virginia), Cubi Point (Philippines), and Mayport (Florida). Each CV carries one CVW, and when not at sea the wing is at its home NAS (Naval Air Station), which may be Oceana (Virginia), Miramar (California), Cecil Field (Florida), Lemoore (California) or Yokosuka (Japan). Different CVWs are at times allocated to each ship, though the same may well be with the same ship for 10 or 15 years, during which time the equipment of the squadrons will change. For identification purposes each aircraft has a two-letter tail code beginning with A for the Atlantic Fleet and N for the Pacific Fleet. Because of the need to keep at least two ships with the 6th Fleet in the Mediterranean or around the Middle East there are typically seven with tail code A and only six with tail code N.

Each CVW is made up of squadrons or single aircraft serving all the necessary major functions. Usually the basis for each wing is two fighter squadrons (VF) and three attack squadrons (VA), but there are occasional variations. The total number of aircraft may be about 85.

Fighter: The standard equipment of the VF squadrons is the Grumman F-14A Tomcat, with the updated F-14C beginning to reach the US Navy in late 1983. Together with a few units still flying the McDonnell Douglas F-4J or F-4S Phantom, these operate in partnership with the Grumman E-2C Hawkeye aircraft to provide the outer defence zone of the fleet. An ITSS (integrated tactical surveillance system) is planned to give longer warning time, especially of hostile aircraft armed with long-range anti-ship missiles. Most CVWs have two squadrons each of 12 F-14s.

Attack: Usually this vital force is divided into two VAs (Light) equipped with the Vought A-7E Corsair II and one VA (Medium) with the Grumman A-6E. Typically there are 24 A-7s and 10 A-6Es, the latter squadron also having four KA-6D tankers. F/A-18A Hornets are replacing A-7s.

ASW: Invariably there is one VS squadron of fixed-wing ASW aircraft equipped with the Lockheed S-3A (later, S-3B) Viking, the normal complement being 10 aircraft. There is also usually an HS helicopter squadron, typically with six to eight Sikorsky SH-3H Sea Kings, to be replaced by 1986 by the Sikorsky SH-60B Seahawk. These helicopters also fly plane-guard, rescue and liaison missions.

Reconnaissance: Following withdrawal of the Rockwell RA-5C, Vought RF-8G and RF-4B (US Marines) from CVWs, the usual reconnaissance platform is the F-14 equipped with the TARPS (tactical airborne reconnaissance pod system).

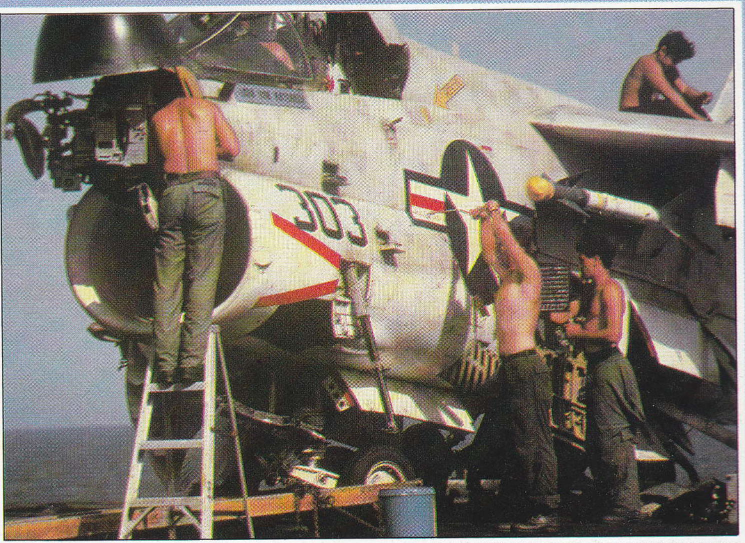
AEW: All CVWs are completely controlled in the air by one or more of the (usually four) E-2C Hawkeye aircraft which equip the VAW airborne early-warning squadron of the wing.

EW: Electronic warfare is handled by the Grumman EA-6B Prowler, four of which are usually on board equipping a VAQ airborne electronic-warfare squadron. They are vital to successful use of the attack squadrons and have many other uses.

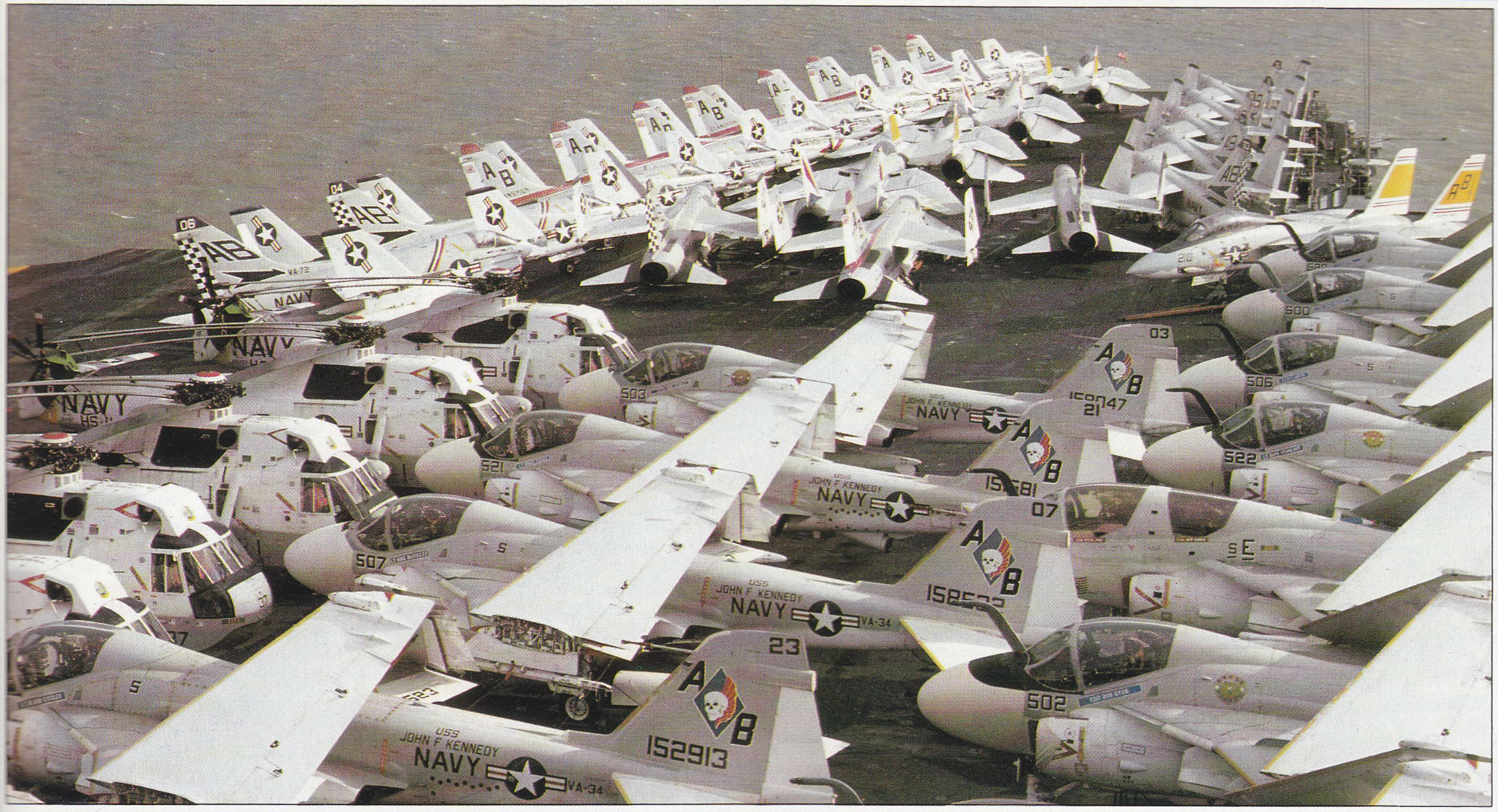
Transport: Each carrier normally has a single Grumman C-2A Greyhound for COD (carrier on-board delivery). This is assigned to the ship, not the CVW, and tail codes are not carried.

Above: Armed with Sparrow and Sidewinder air-to-air missiles, these two Tomcats are receiving maintenance on deck.

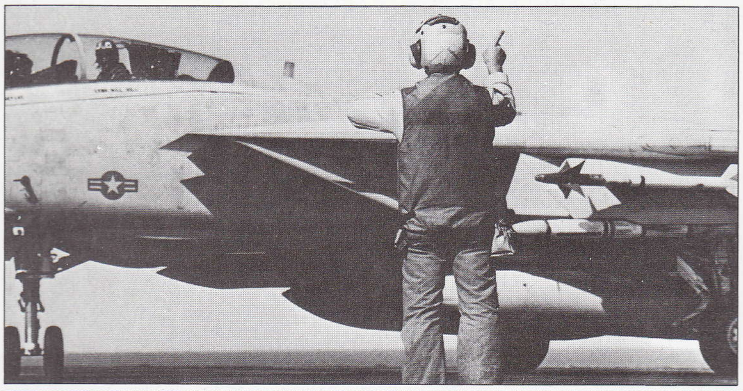
Below: Mechanics work on an A-7 Corsair II. The nose radome has been lifted to reveal the radar for maintenance.



Below: The catapult officer points the way for a Hawkeye to launch. With so many aircraft operating in such a small area, safety precautions are of the utmost importance and men such as these have a vital part to play in the running of air sorties. A landing signals officer ensures that all aircraft effect safe landings on the tricky deck.



Above: Examples of the A-7B Corsair, A-6E Intruder, F-14A Tomcat and SH-3D Sea King are visible in this view of USS John F. Kennedy, *showing the size of the carrier air wing.*



Above: On the deck of Nimitz, crewmen prepare an A-6 Intruder for launching, graphically illustrating the bustle of the carrier deck.

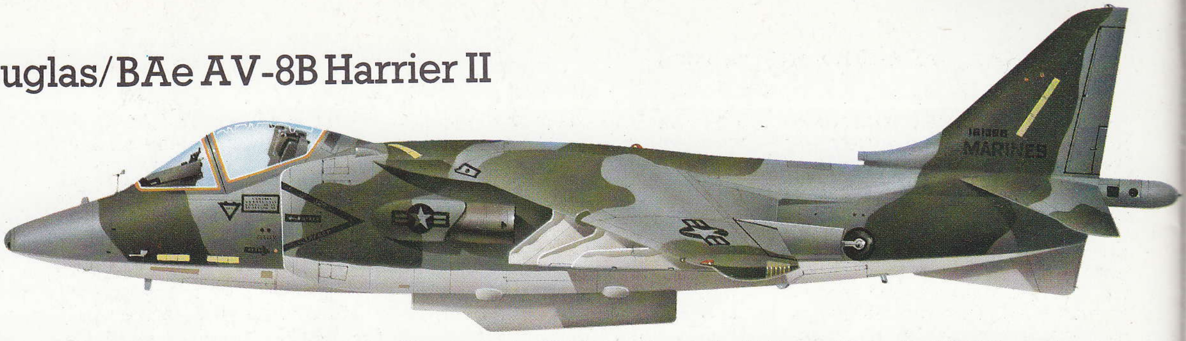
Above: A deck director controls a taxiing Tomcat. The director is an indispensable member of the crew on a crowded flight deck.

Below: A dramatic head-on view of a Tomcat receives attention from deck parties whilst awaiting launch instructions.

Below: Grumman A-6 at sunset. The US Navy has no plans to weaken its carrier fleet and photos such as this will be seen for years to come.

USA/UK

McDonnell Douglas/BAe AV-8B Harrier II



Chosen for the US Marine Corps, the McDonnell Douglas AV-8B is a natural development from the AV-8A Harrier.

For all its remarkable attributes, the original BAe Harrier was no more than a re-engineered version of a technology demonstrator which was to have led to a far more advanced combat aircraft. However, when the British government failed to fund an improved design, McDonnell Douglas and BAe decided to proceed with an improved Harrier, the US firm having acquired development rights for the aircraft as part of the agreement under which AV-8As were bought by the US Marine Corps. Well pleased with their aircraft, the US Marines supported work on an upgraded aircraft, and the resultant **McDonnell Douglas/BAe Y AV-8B** prototype made its first flight at St Louis in 1978.

Featuring a completely new supercritical-section wing (produced to a large extent of carbonfibre) with slotted trailing-edge flaps, an uprated Pegasus 11-21E engine of 9979-kg (23,000-lb) thrust, and a raised cockpit for improved vision, what is now termed the **AV-8B Harrier II** can carry twice the weapon load of the Harrier GR.Mk 3. Totally new gun and ammunition pods are installed, and the wing pylons have been increased in number from four to six to accommodate a prodigious armoury of bombs and rockets, plus Sidewinder AAMs.

Harrier IIs have recently begun service trials with the USMC, which plans to obtain 336 for re-equipment of AV-8A units and five more squadrons currently flying McDonnell Douglas A-4 Skyhawks. All these will regularly undertake shipboard training. In addition, the RAF has placed an order for 60, to be known as the **Harrier GR.Mk 5**, to equip two new squadrons to serve alongside Harrier GR.Mk 3s in Germany, whilst a further 12 will be used by the Spanish navy from the new carrier *Principe de Asturias*, flying from its 'ski-jump' ramp for take-off at maximum weight. The RAF's Harrier GR.Mk 5s will be assembled by BAe, which also has a minority share in manufacture of airframes for the USMC and third parties.

Specification

AV-8B Harrier II

Type: single-seat close-support ship- or land-based attack aircraft

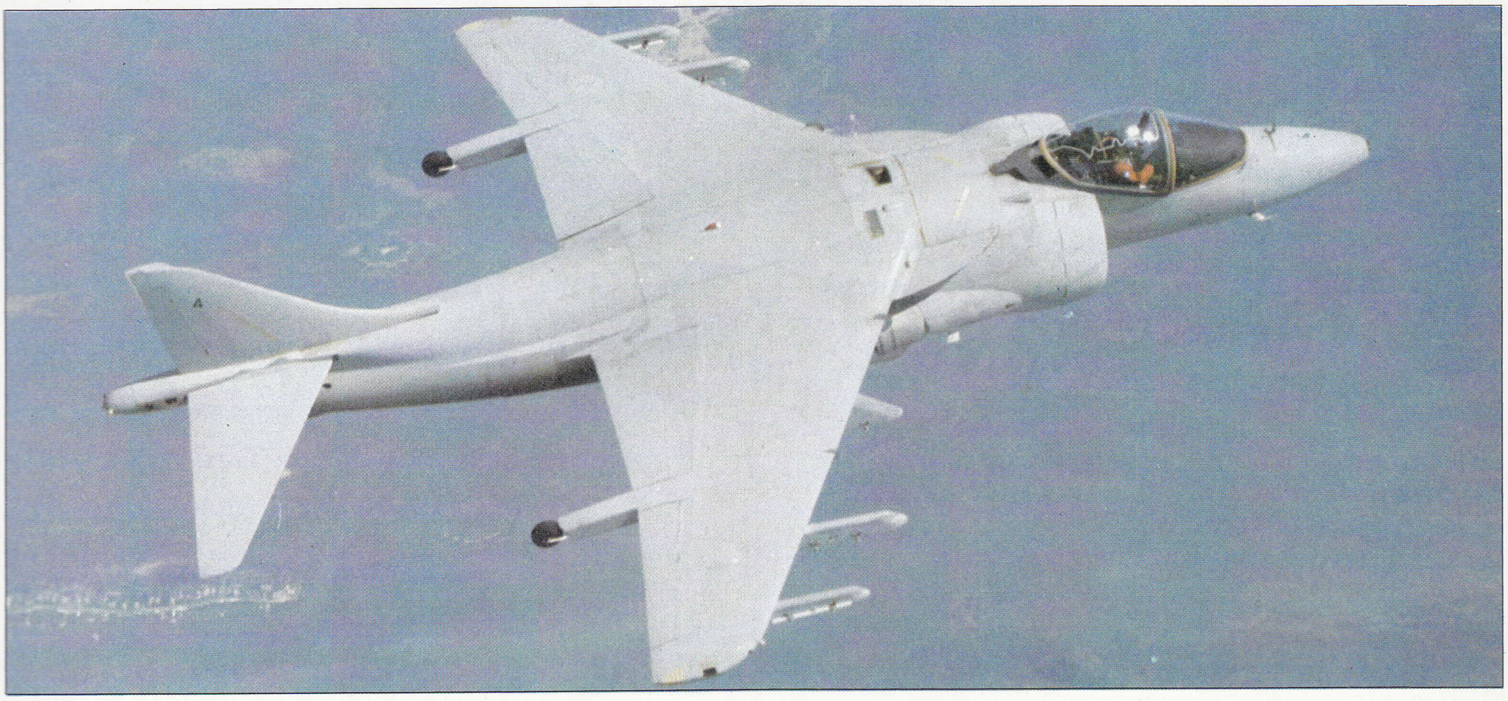
Powerplant: one 9979-kg (22,000-lb) thrust Rolls-Royce Pegasus 11-21E (Pratt & Whitney F402-406) vectored-thrust turbofan

Performance: maximum speed, clean at low altitude 1113 km/h (690 mph); initial climb rate 4485 m (14,715 ft) per minute; service ceiling more than 15240 m (50,000 ft); combat radius on a hi-lo-hi mission with seven bombs plus tanks and after a 300-m (1,000-ft) run 1204 km (748 miles)

Weights: empty 5783 kg (12,750 lb); maximum take-off 13494 kg (29,750 lb)

Dimensions: span 9.25 m (30 ft 4 in); length 14.12 m (46 ft 4 in); height 3.56 m (11 ft 8 in); wing area 21.37 m^2 (230.0 sq ft)

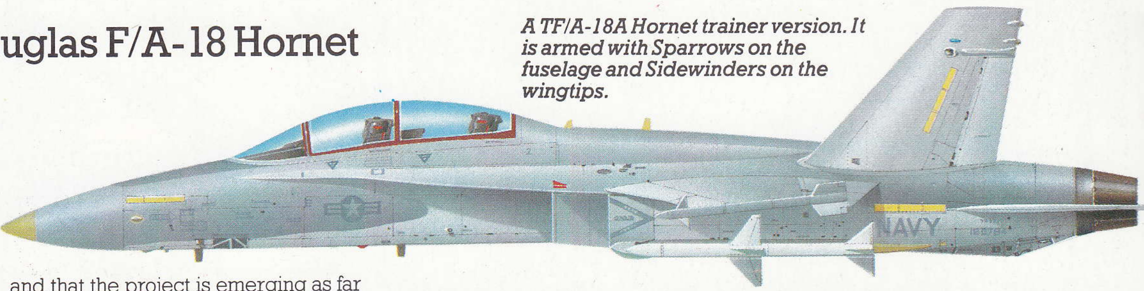
Armament: two cannon pods (USMC, one 25-mm GAU-12/U in one pod with ammunition in the other; RAF, not yet decided) plus seven pylons for total weapon load of 7711 kg (17,000 lb)



This pre-production AV-8B shows the new supercritical wing, LERXs (leading edge root extensions) and reshaped nose that distinguish it from the earlier Harrier.

USA

McDonnell Douglas F/A-18 Hornet



A TF/A-18A Hornet trainer version. It is armed with Sparrows on the fuselage and Sidewinders on the wingtips.

Intended as a successor to the ubiquitous McDonnell Douglas F-4 Phantom and a replacement for the sturdy Vought A-7 Corsair, the **McDonnell Douglas F/A-18 Hornet** is steadily entering squadron service with the US Navy and US Marine Corps, a total of 1,366 being required for these two air arms. Plans are that this agile interceptor and strike aircraft will equip six USN and 12 USMC squadrons in the fighter role, and a further 24 and 20 units respectively in attack roles. The Hornet has performed well during its operational evaluation, turning in high serviceability, although its critics claim that the operational radius with full weapon load falls below specification and that the project is emerging as far more costly than at first intended. Hence there are attempts in some quarters to cut back on procurement.

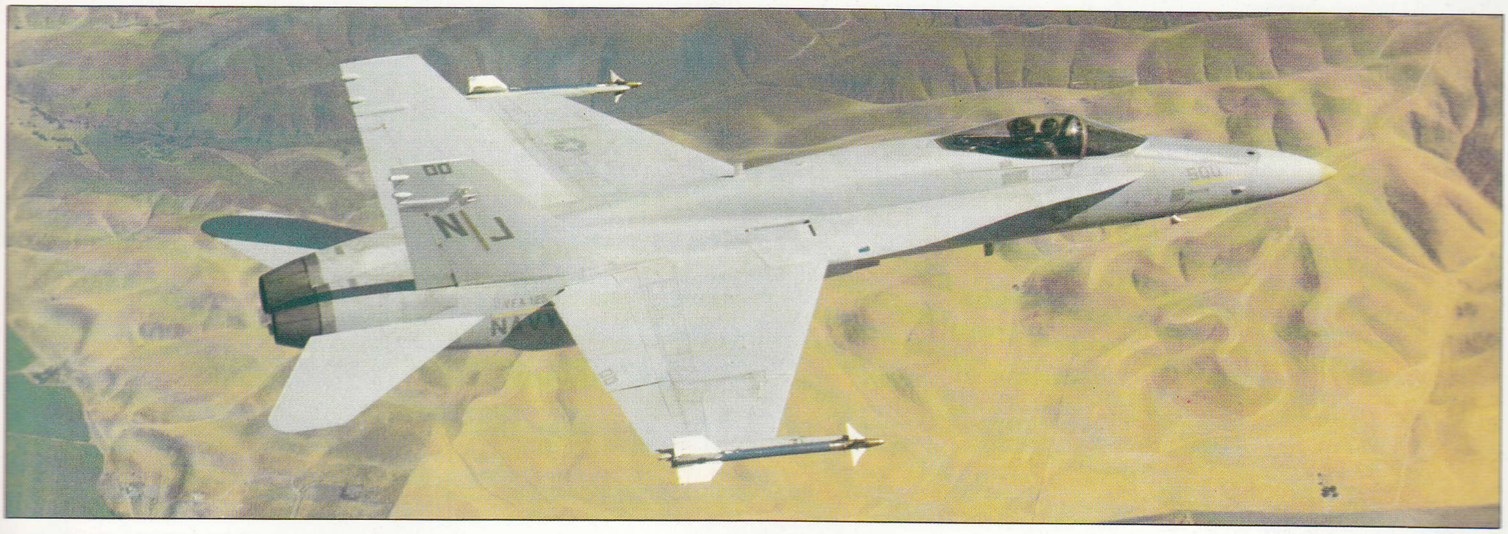
Coming into the world of naval operations by an unusual route, the Hornet traces its history back to the **Northrop YF-17**, which was passed over by the USAF in its Lightweight Fighter competition in favour of the General Dynamics F-16 Fighting Falcon. Seeing potential in the design, the US Navy adopted the YF-17, but commissioned McDonnell Douglas to develop a larger, heavier variant with increased fuel capacity, leaving Northrop as a mere associate contractor, responsible for only 40 per cent of production of the resultant F/A-18 Hornet.

Making considerable use of advanced graphite/epoxy composites in its airframe, the Hornet is optimized for high manoeuvrability, featuring leading-edge root extensions (LERX), leading-edge flaps and drooping ailerons, plus a fly-by-wire control system. An inertial navigation system and head-up display are included in the advanced avionics suite, making the Hornet the most accurate of any carrier-based aircraft in the attack role. Provision is included for additional sensors, such as forward-looking infrared (FLIR), and for a broad range of current and projected weapons, giving a claimed greater 'growth' potential than the F-16. For this reason, and because of the additional security of its two engines, the Hornet has been chosen in recent competitions by the air arms of Canada, Australia and Spain. All these nations have recently operated carriers, but have no ships that can fly the Hornet.

Specification

McDonnell Douglas F/A-18A Hornet
Type: single-seat carrier-based combat/strike aircraft
Powerplant: two 7257-kg (16,000-lb) afterburning thrust General Electric F404-GE-400 turbofans
Performance: maximum speed (clean) Mach 1.8; maximum speed at intermediate power Mach 1.0; combat ceiling about 15240 m (50,000 ft); combat radius (fighter mission, unrefuelled) more than 740 km (460 miles); ferry range (unrefuelled) more than 3700 km (2,300 miles)
Weights: take-off, fighter 15234 kg (33,585 lb); take-off, fighter escort 15875 kg (35,000 lb); maximum take-off 21319 kg (47,000 lb)
Dimensions: span 11.43 m (37 ft 6 in); length 17.07 m (56 ft 0 in); height 4.66 m (15 ft 3½ in); wing area 37.16 m^2 (400 sq ft)
Armament: carried on nine external weapon stations up to a maximum capacity of 7711 kg (17,000 lb) or 6214 kg (13,700 lb) for high-g missions; weapons can include Sidewinder, Sparrow or AIM-120 air-to-air missiles, bombs, air-to-surface missiles and rockets; sensor pods and fuel tanks can also be carried on these weapons stations; inbuilt armament comprises one M61 20-mm six-barrel cannon in the nose

One of the development aircraft assigned to the fleet trials squadron VFA-125 shows the low-visibility scheme carried by all Navy and Marines aircraft. The missiles are Sidewinders.



USA

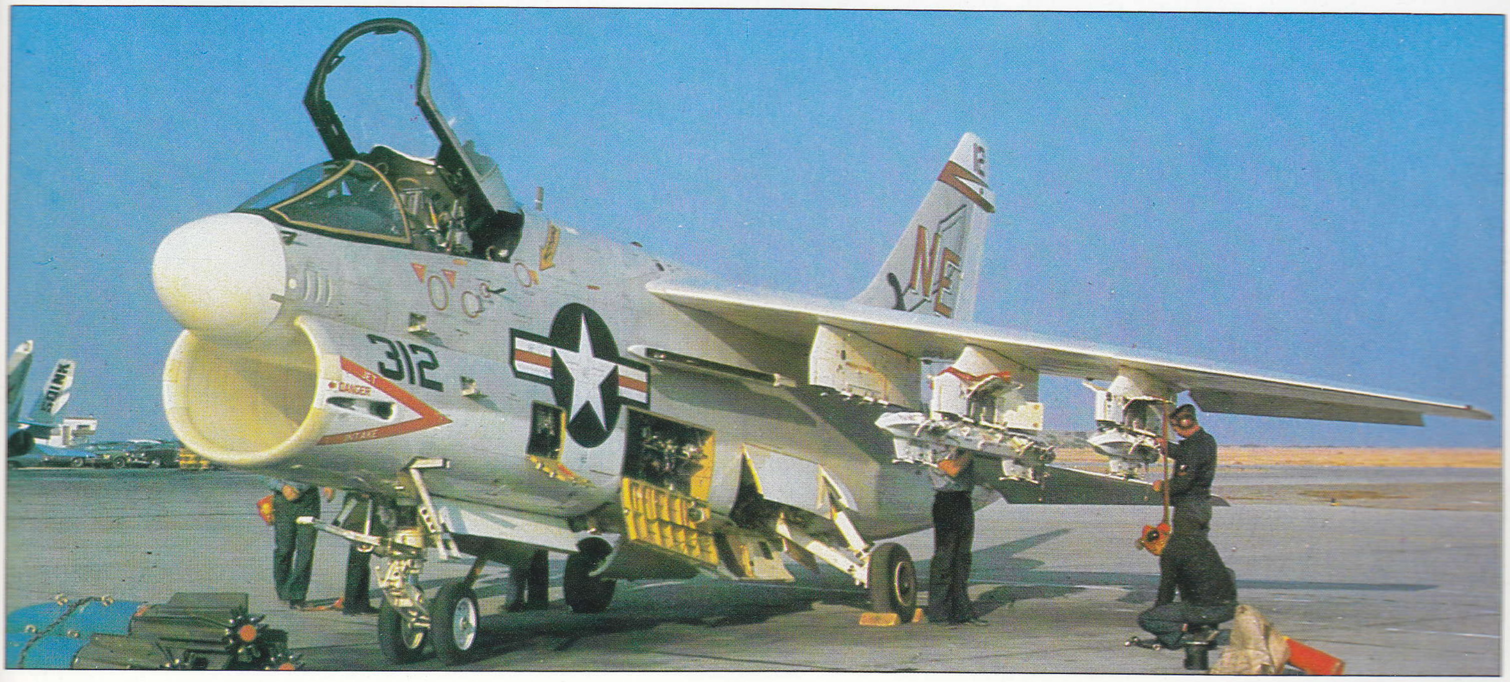
Vought A-7 Corsair II

Sluf (Short, Little Ugly Fellah) as it is affectionately known by its crews, the **Vought A-7 Corsair II** does, indeed, appear to be a stunted version of Vought's earlier creation, the Crusader supersonic naval interceptor. This was not accidental, for when the US Navy called for a Douglas Skyhawk replacement in 1963, it specified a variant of an existing design to ensure speedy and inexpensive development. The aim was achieved handsomely, and after a contract had been placed in March 1964, the prototype flew in September 1965 and production aircraft were bombing targets in Vietnam by December 1967, flying from the USS *Ranger*.

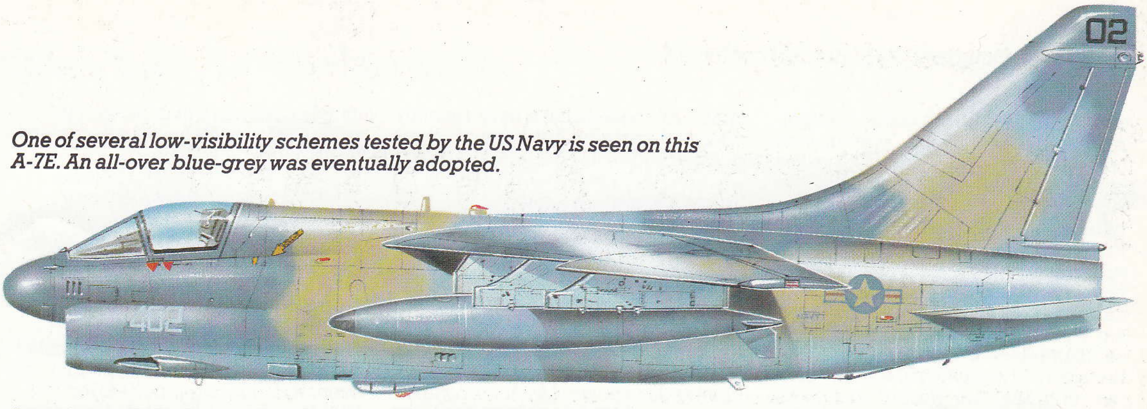
That the Corsair failed to replace the Skyhawk completely was more a result of the latter's remarkable versatility than any deficiency on the part of the former. Corsairs rapidly established for themselves a reputation for weapon carrying and technical reliability, the US Navy accepting 196 each of the **A-7A** and **A-7B** models, both powered by a non-afterburning version of the TF30 turbofan. A more profound change came after the USAF had ordered a land-based version known as the **A-7D**, this featuring completely revised avionics including a greatly improved nav/attack system, and considerably more thrust from the TF41, a US-built enlarged development of the Rolls-Royce Spey.

The naval version of the USAF model became the **A-7E** and proved to be the definitive carrierborne Corsair.

The Vought A-7 has been in service since 1967 aboard US carriers. This early A-7B of VA-113 'Stingers' is being loaded with Snakeye retarded bombs.



Vought A-7 Corsair II (continued)



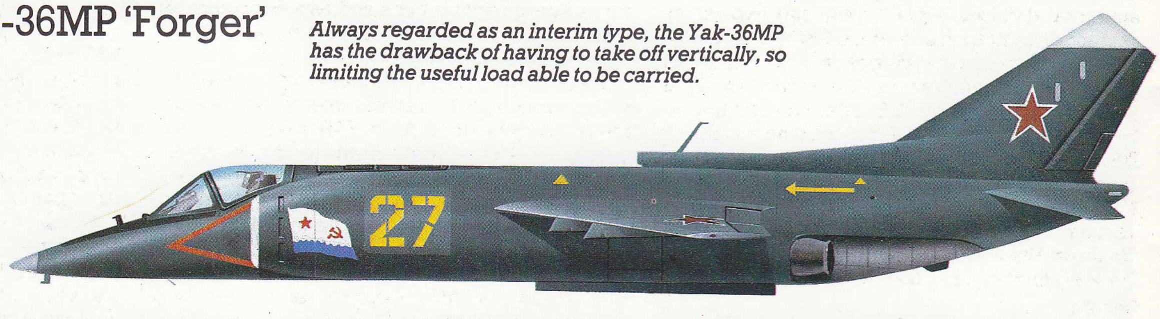
One of several low-visibility schemes tested by the US Navy is seen on this A-7E. An all-over blue-grey was eventually adopted.

with production totalling 551 (plus 67 examples of the TF30-powered **A-7C**). Also blooded in Vietnam, the A-7E has even higher engine power than its US Air Force predecessor. It eventually served with 12 shipboard squadrons of the Atlantic Light Attack Wing and a similar number of units of the Pacific Fleet, together with training squadrons and those of the US Navy Reserve. Corsairs have now been provided with forward-looking infra-red (FLIR) to provide passive night-vision capability, together with further improved avionics and automatic manoeuvring flaps.

Specification
Vought A-7E Corsair II
Type: single-seat all-weather strike aircraft
Powerplant: one 6804-kg (15,000-lb) thrust Allison Rolls-Royce TF41-A-2 turbofan
Performance: maximum speed 1112 km/h (691 mph) at sea level; maximum speed clean 1102 km/h (685 mph) at 1525 m (5,000 ft); ferry range with maximum fuel 4604 km (2,861 miles)
Weights: empty 8669 kg (19,111 lb); maximum take-off 19051 kg (42,000 lb)
Dimensions: span 11.81 m (38 ft 9 in); length 14.06 m (46 ft 1½ in); height 4.90 m (16 ft 0¾ in); wing area 34.84 m² (375 sq ft)
Armament: a wide range of stores totalling more than 6804 kg (15,000 lb) can be carried on two fuselage stations and six underwing pylons, and these can include air-to-air and air-to-surface missiles, TV and laser-guided weapons, general-purpose bombs, rockets and gun pods; inbuilt armament comprises one M61 Vulcan 20-mm six-barrel cannon.

USSR

Yakovlev Yak-36MP 'Forger'



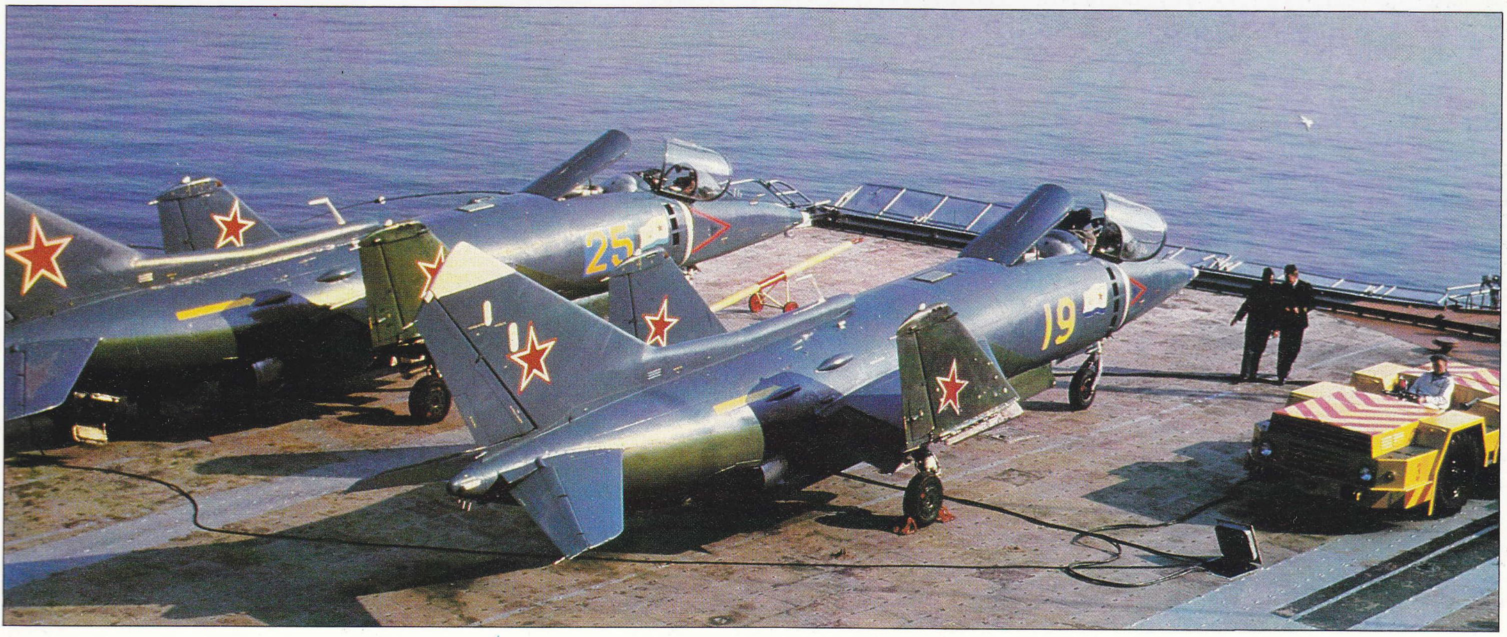
Always regarded as an interim type, the Yak-36MP has the drawback of having to take off vertically, so limiting the useful load able to be carried.

Operated from the three ASW carriers *Kiev, Minsk* and *Novorossisk* the **Yakovlev Yak-36MP 'Forger'** is the Soviet Union's equivalent of the BAe Sea Harrier, although only in the most general of terms. From the 1917 revolution until recent times, the Soviet navy remained a small force with purely local-defence responsibilities, but efforts are currently being made to develop a 'blue-water navy' which already rivals the United States' previously undisputed mastery of the seas. As evidenced by the **Yak-36MP 'Forger-A'** and its two-seat trainer version, the **Yak-36UV 'Forger-B'**, the USSR still has a long way to go in seagoing air-power.

First seen in July 1976, when the class-name ship *Kiev* sailed into the Mediterranean, the aircraft appears to be intended more for operational development than for combat use, although its four underwing pylons indicate some ground-attack potential, and visual air defence will be possible by mounting infra-red AAMs. Unlike the Sea Harrier, the Yak-36MP has no radar except a ranging unit, but most remarkable of all is its employment of two lift engines (dead weight for most of a mission). The almost vertical turbojets are mounted forward and enclosed by doors when not in use, whilst two rear nozzles of the horizontal (main) engine turn downwards for hovering. There is a small toe-in on all four jet pipes.

Restricted by its 1960s technology, the Yak-36MP is incapable of a Harrier-type short take-off to maximize weapon loads. When seen in operation, the aircraft take-off and land vertically, the latter with a degree of precision which suggests some form of shipboard guidance. About 12 'Forgers' are based on each 'Kiev' class vessel, but reports of a larger carrier under construction suggest that a much improved VTOL (or possibly STOVL) aircraft is in prospect.

Specification
Yakovlev Yak-36MP 'Forger-A'
Type: single-seat light VTOL shipboard strike fighter
Powerplant: one 7950-kg (17,526-lb) thrust vectoring turbojet in the rear fuselage, and two 3625-kg (7,992-lb) thrust Kolesov lift turbojets in the forward fuselage
Performance: maximum speed 1170 km/h (725 mph) or Mach 1.1 at high altitude; maximum speed 1125 km/h (700 mph) or Mach 0.8 at sea level; initial climb rate 4500 m (14,765 ft) per minute; sevice ceiling 12000 m (39,370 ft); combat radius 250 km (150 miles) on a lo-lo-lo mission with maximum stores
Weights: empty 7485 kg (16,500 lb); maximum take off 11565 kg (35,275 lb)
Dimensions: span 7.32 m (24 ft 0 in); length 15.25 m (50 ft 0 in); height 4.37 m (14 ft 4 in); wing area 16.0 m² (172.22 sq ft)
Armament: four underwing pylons for up to 1360 kg (3,000 lb) of stores, including AA-8 'Aphid' air-to-air missiles, air-to-surface missiles, gun pods, rocket pods and bombs



This picture of Yak-36MPs on the Russian carrier Kiev shows the intakes open for the two lift jets mounted in the front of the fuselage. These become deadweight when the aircraft attains level flight.

French Army

A Legionnaire of the 2^{e} Régiment Etrangère Parachutiste checks his equipment. The MAS 49 rifle shown is gradually being replaced by the ultra-modern FA MAS assault rifle.

The French army is in the odd position of being both a part of the NATO strength and yet organized in such a way that it does not act as part of that strength. On paper the French armed forces are part of the NATO armed forces, but ever since President de Gaulle withdrew France from the alliance in 1966/7 the French army has had few contacts with other NATO forces other than formal liaison. The French army does not take part in NATO exercises and goes its own way when it comes to NATO inter-operability programmes (with some notable exceptions such as the MILAN anti-tank missile).

For all that, the French army maintains a sizeable force inside West Germany to the tune of three armoured divisions (48,500 men) and two regiments (one infantry and one armoured) in West Berlin. The three armoured divisions in West Germany form the 2^{e} Corps d'Armée (CA, or corps) and are the 1re Division Blindée (DB, or armoured division) based at Treves, the 3^{e} DB at Freibourg and the 5^{e} DB at Baden. The 2^{e} CA is headquartered at Landau. To back up these 'front-line' formations there is the 1er CA with its headquarters at Metz, having under its command a further five armoured divisions. These are the 4^{e} DB (Nancy), 6^{e} DB (Strasbourg), 7^{e} DB (Besançon) and the 10^{e} DB (Châlons-sur-Marne).

The third corps, the 3^{e} CA, is based at St Germain en Laye and controls the remainder of the major French army formations based in France and Corsica. These are made up by seven infantry divisions (Divisions d'Infanterie, or DI), one more armoured division and a motorized brigade (the 31^{e} Brigade). The armoured division is the 2^{e} DB based at Versailles. Of the seven infantry divisions, three have their own speciality. One is the 9^{e} DIMA (Division d'Infanterie de Marine) based at St Malo. As its title implies, this is a division that acts as a marine force in association with the French navy for amphibious operations. Another 'special' division is the 27^{e} DA (Division Alpine) headquartered in Grenoble close to the French Alps, where the division nominally operates. The third special formation is the famous 'Paras', the 11^{e} DP (Division Parachutiste), which has its headquarters in Toulouse though many of its units are based in Corsica along with the 31^{e} Brigade.

To confuse matters somewhat the French army is now forming its own RDF-type force to be known as the Force d'Action Rapide, or FAR. When complete the FAR will have five major formations as its core. Three of these are already in existence as they are the three 'special' divisions (9^{e} DIMA, 11^{e} DP and 27^{e} DA). To these will be added two new divisions, the 6^{e} DLB (Division Légère Blindée, or light armoured division), which will be the present 31^{e} Brigade enlarged in numbers and equipped with mainly light armoured vehicles, and the 4^{e} DAe (Division Aéromobile, or airmobile division), which will be a combat helicopter division equipped with some 120 anti-tank helicopters and 80 transport helicopters.

The French army also has a share in the French nuclear deterrent, approximately 5,500 soldiers manning some of the posts allotted to the French strategic nuclear forces.

To back up these core formations the French army deploys three logistic brigades, five army corps regiments with such special functions as reconnaissance, motorized rifle and drone reconnaissance, and a further seven independent regiments. Four of these independent regiments are combat engineers, two are parachute regiments and one is devoted to electronic warfare. Among the equipments in use are the EBR and AML heavy and light armoured cars (428 and 680 respectively in service), to be supplemented by 110 ERC-90S armoured cars on order.

French army aviation deploys over 6,600 men allotted to six combat helicopter regiments with a further seven light groups and two flying schools. The bulk of the aircraft used are helicopters, together with some small fixed-wing aircraft.

These French army units operate all over the world. The present 'overseas intervention' force is the 31^{e} Brigade, though the FAR will one day take over many of its present responsibilities. Apart from this force the French army has at any one time formations in the Antilles, Chad, the Central African Empire, Djibouti, Gabon, New Caledonia, the Ivory Coast, Polynesia and Senegal. A small force of 911 soldiers is part of UNIFIL in Lebanon, and a training team is active in Zaire. A further team of technical advisers is at present in Saudi Arabia.

To man all these formations the French Army has a strength of 311,200 of whom 6,700 are women. Of this number 195,000 are conscripts who serve for one year (18 months if posted to an overseas unit). To add to this number there are reserves of 281,000 who would form 13 infantry divisions (three formed from personnel in training schools). The complete reserve unit strength is 65 regiments.

Equipment

To give an impression of the equipment used by the French army it would be as well to analyse the strength of an armoured division, which has a manpower strength of 7,000. Each armoured division has its own headquarters with signal, intelligence and other associated units. Under this headquarters are two armoured regiments equipped with the AMX-30 main battle tank. Each division has 148 AMX-30s, each armed with a 105-mm (4.13-in) main gun. These AMX-30s are due to be replaced gradually by the updated AMX-30B2, which retains the 105-mm (4.13-in) gun but has improved fire-control and other systems. The French army has in all some 1,210 AMX-30s but only 30 AMX-30B2s (a further 800 are on order). The AMX-40 is a new tank nearing production.

Each armoured division has two motorized infantry regiments equipped with the VAB armoured personnel carrier. There are 115 of these to a division, each carrying 10 soldiers and a crew of two. The division also has 132 AMX-10 infantry fighting vehicles (from a total strength of 774 with 830 more on order), which can carry either four or eight soldiers (depending on the armament carried) with a crew of three. The tracked AMX-10 may be fitted with a variety of weapons including a 20-mm cannon, anti-tank missiles or a 90-mm (3.54-in) gun.

Under headquarters control is a reconnaissance squadron using French-built Jeeps equipped only with light weapons such as machine-guns and some anti-tank missiles. Anti-tank missiles are also used by the divisional anti-tank company. The main French army anti-tank weapon for the infantry is now the MILAN (1,400 in service with 1,500 on order) an internationally-developed missile manufactured in a number of countries, but the armoured division is also equipped with a small force of 12 VAB wheeled carriers using the all-French HOT anti-tank missile which has a longer range than the man-portable MILAN. Total VAB/HOT strength is 42.

To be continued

Foreign Legion paratroops remain amongst the elite of French forces, and constitute an important element of the 'Force d'Action Rapide' (Rapid Intervention Force).